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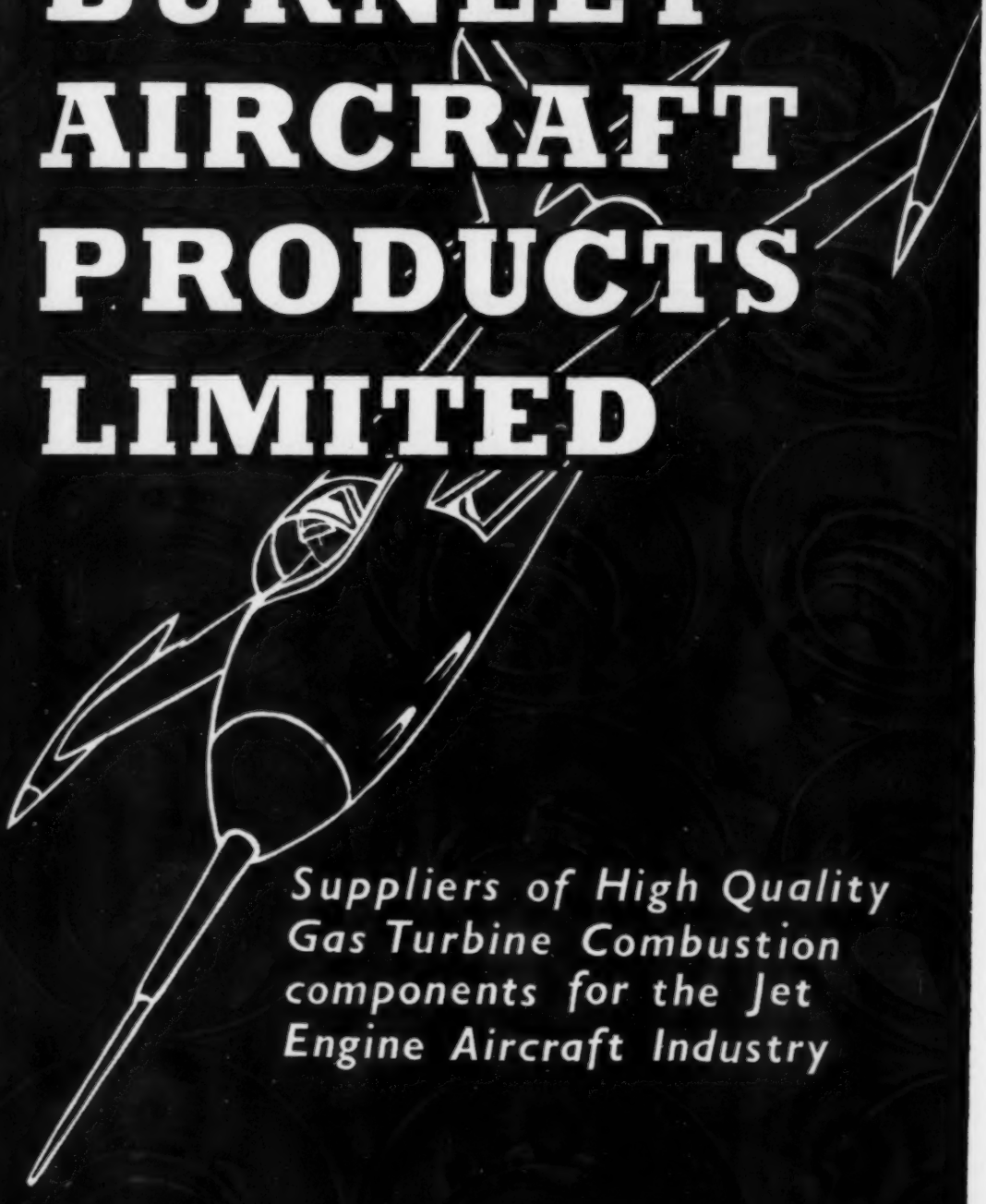

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A WORLD OF VIBRATION

Vibration technology is a comparatively new development in the field of environmental engineering. Its applications in measuring metallurgical stresses and strains, in simulating fatigue to destruction point, are fairly well-known, but even the present scope is far wider than these. The potential is immense to a degree which possibly outreaches that of any other applied science. It is even possible that there is much to be rediscovered, for the histories and mythologies of ancient civilizations abound in references to physical motion achieved through sound vibrations. The destruction of the walls of Jericho is an example; and it has been suggested that the Pyramids' vast masonry was elevated by similar means. But fascinating and perhaps revealing as that line of inquiry may be, this report will deal principally with the immediately practical uses of vibration testing.

From eyes to motor cars is an apt and related part of the applications range. Taking the first and uncomfortably picturesque example, an incidence of severe headaches and impaired vision suffered by transport drivers led to tests with vibration equipment. These showed that through vibration on certain road surfaces, the drivers' eyes were being literally bounced back and forth in their sockets.

MOTOR VEHICLE INDUSTRY

Car bodies and their attachments are subject to mechanical and other vibrations transmitted through suspension systems. What with wear and tear and varying concern for maintenance, the noises which can result are an age-old problem at the service station. The drumming heard by the owner 'under the back seat somewhere' is usually non-existent in normal workshop testing; out on the road it's audible but locating it is a tedious and uneconomic guessing game.

Yet further complications arise out of the fact that the vibration source may be far removed from the apparently offending component or structure.

We have a compact generator/oscillator/power amplifier combination by which all the running vibrations can be simulated *in the workshop* and the noise source accurately and quickly located. Similar equipment is used by car manufacturers so that vibrations can be compensated or designed out.

ROAD CONSTRUCTION

Roads, too, can be investigated with vibration equipment. An applied vibration is picked up at a distance, on an oscilloscope. The signal time and strength factors vary according to the nature and thickness of the surface and subgrade materials. By these readings it can be determined whether or not the construction is according to specification. Periodic tests will reveal the extent of any deterioration. In research, the behaviour of roads under various traffic conditions can be established and the information used in framing specifications for new roadworks.

AIRCRAFT INDUSTRY

In the aircraft industry, vibration testing has long been a vitally important technique. Bearing in mind the possible outcome of the failure of quite small components, vibration problems in land vehicles and structures pale into comparative insignificance. Goodmans equipment is widely used to test dynamic models . . . even whole aircraft . . . and on the multiplicity of instruments and electronic apparatus.

The tremendous power and complexity of rocket-propelled vehicles set still more exacting requirements and for these Goodmans are producing special generators.

OTHER APPLICATIONS

The miscellany of these is far too extensive to catalogue here, but the following will serve to demonstrate the scope.

In fatigue testing, vibration generators provide wide range and prolonged consistency.

Chemical and bio-chemical research are served by our smallest generator, the V47, in mixing, emulsifying and the measurement of interface potentials. It has been used also to simulate nerve signals and to assess vibration effect on living tissue. Experiments show that physical vibration and 'white noise' have anaesthetic properties.

Vibration equipment is used in the rubber, plastic and textile industries, as an aid in establishing the materials' mechanical properties.

Experiments in the machine tool industry have shown that small and carefully controlled vibrations can, in fact, improve stock removal, surface finish and minimize the effect of certain operations upon molecular structure.

This is inherently a world of movement. Everything vibrates within itself and often as an entity. These forces can be observed, reproduced, supplemented. There must therefore be many functions for our vibration equipment which even we can only guess at . . . and even more as yet unthought of. Name your problem; consider what may be done better, faster, more economically . . . what may be done perhaps for the first time, with the help of vibration equipment. It's more than likely that the means to the end is ready-made.

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FLIGHT

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Editor-in-Chief
MAURICE A. SMITH DFC

Editor
H. F. KING MBE

Technical Editor
W. T. GUNSTON

Air Transport Editor
J. M. RAMSDEN

Production Editor
ROY CASEY

Managing Director
H. N. PRIAULX MBE

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Towards Co-operation

ADVOCACY of a "fly British" policy, by Mr Peter Masefield in his Sixth Sir Henry Royce Memorial Lecture, *Civil Aviation—a Forward Appraisal*, was sharply challenged by Mr J. D. Pearson, Rolls-Royce chief executive. It emerged from later discussion that Mr Masefield had mainly in mind the airline corporations. He himself said that he would like to see more getting together between Europe and America.

The exchanges of views between these two leading personalities brought forth some salutary home truths from Mr Pearson in particular. Overseas customers, he said, were essential for our aircraft industry, and these would not be available if there was no give-and-take and if Britain never bought aircraft from abroad. Our aim should be to play a leading role in Europe. "Unless the industry is careful," Mr Pearson declared, "its only customers in future will be the British Services and airline corporations." He gave warning that the business from these sources was insufficient to support an industry which, if it did not take its chance to play an important part in Europe, would expire.

These are the thoughts of one of our greatest industrialists, and we find ourselves much in accord with our French contemporary *Les Ailes*, which points out that industrialists and technicians have been ahead of governments in trying to work on an international scale. International licence-production of the F-104 fighter/bomber, and of the Sidewinder and Hawk missiles is proving successful, and the Breguet Atlantic programme has, our contemporary remarks, demonstrated that design and development also can be successfully achieved. "The Atlantic programme," adds *Les Ailes*, "has demonstrated that the newer programmes for V/STOL fighters and transports are feasible, and similar space programmes can be set up." It is now up to governments to confirm and support what industries have achieved.

There is every hope of a richly rewarding collaboration between, for example, the British Aircraft Corporation and Sud-Aviation, and not on supersonic transports alone. Indeed, the manufacture of components for BAC aeroplanes is but one of numerous possibilities which could alter the whole outlook and complexion of Britain's aircraft industry.

Our Own Part

For our own part, we on *Flight* have always believed in practising what we are now preaching. Those pioneer examples of co-operation the Friendship and Caravelle received exactly the same treatment at the hands of our artists and writers as did the Viscount, Comet or Argosy, and it is especially pleasing to us that our friends at Fokker and Sud have been able to make extensive use of original *Flight* material in promoting the sale of their aircraft. Our lengthy progress report last week on the Breguet Atlantic was another earnest of our continuing goodwill and endeavour in the cause of co-operation, and our account of the vast F-104G programme (October 19) was by far the most detailed to be published in any journal. We hope we shall not be guilty of immodesty if we add that our reports of European spaceflight proposals and negotiations have been not only extensive but, in two extremely important instances, exclusive. We recount these items merely as an affirmation of policy.

"Fly British" continues to be a worthy motto. "Vive coopération" will be our watchword for the years ahead.

FROM ALL QUARTERS

Bristol Siddeley Buy D.H. and Blackburn Engines

ON November 8 Hawker Siddeley Aviation issued the following statement:

"The Hawker Siddeley Group Ltd and Bristol Siddeley Engines Ltd have announced jointly that Bristol Siddeley has acquired from Hawker Siddeley the full share capital of Blackburn Engines Ltd and the de Havilland Engine Co Ltd, which will now become part of Bristol Siddeley Engines Ltd. This arrangement is in line with the Government's policy to concentrate aero-engine work into two companies."

Sir Roy Dobson, HSG managing director, said that the sale had been made for cash. He described it as "a tidying-up process—all part of our rationalization programme, which is going on apace." HSG owns 50 per cent of the share capital of Bristol Siddeley.

A Bristol Siddeley spokesman said that the transaction would mean that his company's already extensive range of products—which in the aeronautical field includes gas turbines, rocket motors and ramjets—would be augmented by the excellent Gnome and Nimbus turboshaft units on which de Havilland and Blackburn had concentrated in recent times. Bristol Siddeley would now be able to offer powerplants ranging from the smallest to the largest.

The deal was a well-kept secret. D.H. Engines and Blackburn Engines, which respectively add about 8,000 and 1,000 people to the previous BS total of 24,000, will not at present lose their identity, nor is any major change in their activities anticipated. It is clear, however, that the November 8 announcement was made the moment the transaction took place, and the obvious questions regarding redisposition of work, boards of directors and rationalization into the two BS divisions—"Aero" and "Power"—must for the time being go unanswered.

More Comets for Egypt?

EARLIER this week it was reported that United Arab Airlines are negotiating with the de Havilland Aircraft Co Ltd for two more Comet 4Cs, for early delivery, to increase the airline fleet to seven. The de Havilland Co can make no comment on this report, but it is understood that two aircraft already well advanced on the production line can be made available to UAA for early delivery if required.

VIP Canberra

THE Canberra in which Mr Duncan Sandys was flown home from Tripoli to London Airport on November 8, after his Britannia had been delayed by engine trouble, was a B(I).8 of 88 Sqn flown by Sqn Ldr J. D. Upton. Normally based at Wildernath, Germany, this aircraft was at RAF Idris for routine training. The flight to London, of about 1,450 miles, was made in 3hr 16min. Mr Sandys travelled in the navigator's prone position in the nose of the aircraft.

Starting-up Again

HAD the pioneer aviators been able to obtain engines with reasonably reliable power output and a weight within bounds, at least a few would probably have been able to fly before the turn of the century. Memories of the power problems of the earliest days of flying were recalled last Monday when Sir Geoffrey de Havilland joined with founder-members of the company bearing his name, and a few guests, to "start up" a replica of his first engine.

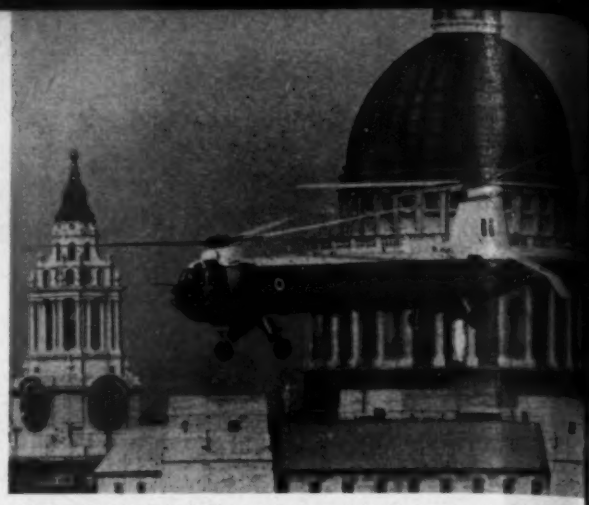
This had been built over a period of three years by some 60 apprentices of the de Havilland Engine Co as part of their training. As no original drawings existed, the engine was redesigned, largely on the basis of contemporary sections which appeared in *Flight* for May 21, 1910, and on Sir Geoffrey's recollections of the original. Four of these engines were made in the first place by the Iris Car Co of Willesden—two were for Mr G. de Havilland and two for Farnborough for airship installation.

With the aid of an entirely modern electric starter, the replica started immediately at the push of a button, and it idled evenly and smoothly; but any attempt to produce a part of its original 45-50 b.h.p. at 1,500 r.p.m. resulted in considerable vibration. This replica weighs about 30lb more than did the originals and has cast-iron pistons in place of the special steel ones. Sir Geoffrey explained that the couple resulting from this five-litre flat-four engine with two-throw crankshaft called for braces from the cylinder heads in the horizontal plane. In his aircraft these had been provided, but the engine still shook badly at full power.

In the first—unsuccessful—installation the engine was mounted with crankshaft transverse and driving bevels for the shaft for the two propellers, one at each end. Next a single pusher propeller was used, and this allowed the crankshaft to be fore-and-aft on the aircraft centreline.

Sir Geoffrey mentioned at lunch that his wife had found the original drawings some years ago and, thinking them so old as to be without value, had put them on the bonfire. He complimented the apprentices on building the replica engine without real drawings but added that he did not think there were "any particular lessons to be learned from this."

Mr F. T. Hearle, who was associated in the first projects with Sir Geoffrey, was unwell and therefore unable to be present at the ceremony.



SOMETHING IN THE CITY (or What Would Sir Christopher Have Said?)—a Westland Belvedere rehearsing for the RAF's Lord Mayor's Show participation (incidentally a few hundred yards from "Flight's" offices). In spite of atrocious weather on Saturday—the day of the actual show—the whole helicopter programme, with the Belvedere, a Sycamore and Whirlwinds participating, went as planned

A Look at Life

THE life of a test pilot—Jim Dell of English Electric—is the theme of one of the latest editions of the *Look at Life* series of films produced by Rank Film Distributors Ltd. Some superb flying sequences are introduced, and there is a particularly dramatic "killing" of a Meteor target by a Firestreak missile.

Hiller's Little Big Helicopter

FLIGHT-TESTED in secrecy over the past six months, a new six-seat utility helicopter has just been announced by Hiller. Powered by the Canadian Pratt & Whitney PT6 of 500 s.h.p., the newcomer is designated the Ten 99 (or, as the manufacturers rather inelegantly render it "Ten99"). The PT6 is the only North American light-helicopter turbine to have passed the 50hr US Government qualification test, and the new Hiller is the first aircraft to be powered by it (excluding the Beech 18 test-bed).

A private venture, the Ten 99—"the smallest big helicopter flying"—is intended for a wide variety of rôles, including fleet utility work, Marine Corps assault tasks, and general-purpose civil passenger and freight duties. Although no greater in overall dimensions than the Hiller 12E, it has twice the seating capacity; payload is in excess of 1,000lb.

Unique in the light-helicopter class is the provision of large aft-loading clamshell doors for the 100 cu ft box-like cargo compartment. In addition there are four doors for passengers and crew and to assist in through-loading of the cargo section.

Studies for the Ten 99 began late in 1958, and preparations for production have included market evaluation, wind-tunnel testing and the manufacture of a full-scale mock-up which has been transported to various places in order to obtain reactions from prospective customers. Application for type certification was made to the FAA last summer.

NEW HILLER: the six-seat Ten 99, subject of a news-item above

ON SCHEDULE, the first of the three Argosies for BEA was handed over on November 6 at Whitworth Gloster's Bitteswell airfield. At the ceremony were (l to r) Mr D. A. Woodley, WGA transport aircraft project and development manager; Mr H. F. Butler, WGA project designer; Mr J. P. Golding, BEA type-engineer, propeller turbines; Capt E. Smith, BEA (who flew the aircraft to the corporation's Stansted training base); Mr E. D. Keen, WGA director and chief engineer; Mr J. Austin, WGA assistant chief inspector. The photograph was taken in the Argosy's hold, which is metal-lined to BEA requirements

Air Cdre Banks on Engine Development

AN historical review entitled *The Aero Engine in the Twentieth Century* was the subject of the Sir George Cayley Memorial Lecture delivered before the Brough Branch of the Royal Aeronautical Society on November 8. The lecturer was Air Cdre F. R. Banks.

Of particular interest, in the air commodore's written paper, were his remarks on the development of fuel, with which, in former years, he was particularly concerned. He said: "Since fuel played a most important, almost vital, part in the development of the piston-type aero engine, a word on fuels generally would not be out of place. The more active and intensive period of fuel and engine development occurred in the 20 years between 1930 and 1950, and the fuel specified by the Air Ministry in 1930 had a knock rating of 73-77 octane and consisted of a mixture of 80 per cent 'straight run' aviation gasoline and 20 per cent benzole. Comparing that fuel with modern 115-145 Grade, engine performance was increased in that 20-year period by about 200 per cent, with a corresponding improvement in fuel consumption of 20 per cent, though, naturally, there was also considerable advance in engineering techniques and metallurgy at the same time. A further example: the Liberty engine of the First World War gave 400 b.h.p. on 58 octane fuel, but the Merlin gave more than 2,000 b.h.p. on 150 Grade fuel—both engines having the same piston displacement. Leaded fuel of 87 octane was first introduced into this country in the early thirties and used for all British military engine development from 1932 onwards, to be followed by 100 octane fuel—at first for engine development but eventually replacing 87 octane fuel in the Second World War. Full credit for both fuels goes to the US Army."

The air commodore's summary of plug development was also of particular interest. He said: "Up to the beginning of the Second World War, mica was the insulating material, but it was not standing up well to the increasing power outputs. Just before the war, Siemens, in Germany, had developed an insulator of sintered aluminium oxide, which was fired in a kiln at very high temperature (about 1,700°C). Afterwards, Bosch produced a variant of the Siemens material; and then A.C., K.L.G. and Lodge started to develop sintered aluminium oxide insulators for their plugs. A.C. made use of the original Siemens material (Sinterkerund), while K.L.G. took a licence from Bosch. Lodge developed a very successful insulator of the same basic material along their own lines, i.e., Sintox. All these ceramics had fluxing agents, which helped to reduce the sintering temperature somewhat. An important British sparking-plug development was the fine-wire electrode of platinum alloy, originally introduced by K.L.G."

New Midlands Club Activity

THAT club flying in the Midlands is in a healthy state was indicated by the opening of the newly formed Coventry Flying and Country Club last Saturday by Ald W. Callow, Lord Mayor of Coventry. Not to be confused with the long-established Coventry Aeroplane Club, the aim of this organization—based at Baginton and associated with Devonair Ltd—is to provide tuition to CPL standard. At the same time the social side will be well catered for. There are two bars, a large ballroom with organized dancing at weekends to a live band; and a first-class licensed restaurant.

Devonair will provide and service the club aircraft, and economical flying is available on a Tiger Moth, a Magister and an Auster Mk 5; hourly charges will be £3, £3 5s and £3 12s 6d respectively. There are also a Chipmunk for £5 an hour and a Tri-Pacer at £6, while twin-engined tuition is available on an Apache for an hourly rate of £20. Devonair own G-AEWZ, one of the two remaining D.H. Dragonflies, which is currently undergoing repairs after a ground loop at Elmdon. When this aircraft is in commission the club hopes to offer twin flying at £10 an hour.

In addition to the social amenities in the club-house, briefing rooms, radio cubicles and a D.4 link trainer will be available.

TURBINE-POWERED developments of the Soviet Mi-1 and Mi-4 helicopters are the V-8 (top) and V-2. According to "Soviet Weekly," they have the same dimensions and weights as their piston-engined precursors, but carry substantially increased payloads. Thus, the V-2 takes from six to eight passengers (the Mi-1 carried only two) and the V-8 seats 20-26

IN BRIEF

FROM MINISTRY TO INDUSTRY: On his retirement from the post of Director-General of Engineering, Air Ministry, AVM G. Silyn-Roberts, CB, CBE, AFC, has joined Electro-Hydraulics Ltd as engineering consultant. In addition to advising on technical matters, AVM Silyn-Roberts—who will continue to reside in London—is to assist the company in maintaining closer liaison with the aircraft industry

Mr J. E. Armitage has been appointed comptroller of British Aircraft Corporation. He will continue for a limited period as commercial director of Vickers-Armstrongs (Aircraft) Ltd.

The Kronfeld Club's fourth annual exhibition of aviation paintings and drawings was due to be opened yesterday (November 15) by Peter Scott. Held at the club's premises at 74 Eccleston Square, London SW1, the exhibition will continue until November 25.

Twenty-first anniversary of the establishment of Napier's Luton Airport factory was marked recently by the presentation of a pair of silver candelabra for the Corporation's plate and regalia. At a ceremony at the Town Hall, the Mayor (Ald G. L. Matthews) received them from Mr C. L. Cowdrey, general manager of the company's Luton Division. "Napier," said the Mayor in a speech, "is a credit to the industrial life of the town."

The first F-104G to be completed by Arge Nord flew from the 10,000ft runway at Schiphol on November 11. Assembled by Fokker from components shipped by Lockheed, Canadair, and other transatlantic companies, it was airborne for 25min in the hands of A. P. Moll, chief test pilot, who exceeded M1 on the climb and carried out most of the first test at approximately M1.5. The aircraft is stencilled KG-101 and is destined for the Luftwaffe.

Mr J. A. Corner, chairman and managing director of Cornercroft Ltd, the well-known Coventry engineering group, is retiring. He founded the original company in 1919, with Mr Norman Rycroft, to produce "Ace" wheel discs and other motor accessories. Since then the business has expanded steadily, and during the war additional factories were acquired for aircraft component and other precision engineering work. Aircraft sub-assemblies and sheet-metal products have continued to form a large proportion of Cornercroft output, which has also extended to other fields, including plastic moulding.

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BIG DAY FOR THE BIRDMEN

Above, Derek Piggott balances the aircraft by means of its ailerons in a wind of 3-5kt prior to flight. Above left, close-up of aircraft showing the pylon on which the 8ft diameter propeller is mounted

WHOEVER wins the Kremer Prize for the first manpowered flight around a specified figure-of-eight course, the credit for being the first to get off the ground unaided in a man-powered aircraft must go to the group of Southampton University graduates led by Miss Anne Marsden, Alan Lassiere and David Williams. Their aircraft, illustrated on this page, has been undergoing tests at Lasham Airfield for the past two months, and on Thursday of last week, November 9, 1961, with Derek Piggott at the controls, the machine succeeded in taking off, making a flight of 50-70yd, and attaining a height above the runway of about 5ft. This flight was made with no tow or external assistance of any kind, and no power other than the cycling action of the pilot.

Most of the members of the Southampton group are post-graduate research students in the University's Department of Aeronautics and Astronautics. Design work began in July 1960, construction was started in December 1960, and construction was completed in September 1961. The aircraft was built in the Sir George Edwards Structures and Vibrations Laboratory at the university, and assistance was received from the Aeronautics Department. The project enjoyed the approval of the Head of the Department, Prof E. J. Richards—but not his conviction that the objective was possible. As reported at the time, the group was one of two to receive a Royal Aeronautical Society grant (amounting to £1,500) in March of this year.

At Lasham the group has had the assistance of Lasham Gliding Centre, and in particular the services as test pilot of the centre's chief flying instructor, Derek Piggott. It appears from Piggott's initial experience with the aircraft that, at this stage of the game, piloting skill and experience is of greater importance than athletic or muscular prowess.

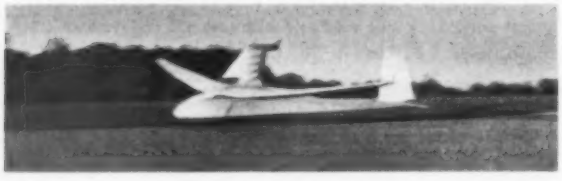
Piggott has stated that flying the machine is probably outside the ability of the average pilot. Most of the difficulty in fact arises on the ground, and a number of ground loops have been experienced following violent swings which the pilot was unable to control. Landing the aircraft was described by Piggott as "quite a handful."

The Southampton group's designated pilot for their attempts on the Kremer Prize is Martin Hyman, an Olympic runner, who at present is learning to glide at Lasham. Last week's performance by Derek Piggott might indicate that the best chance of success may well be to train a good pilot to be athletic rather than an athlete to fly.

From the outset, the 80ft span aircraft was designed to standard glider techniques, and to comparable load factors, although its weight (130lb) is very much less than that of any normal—and much smaller—sailplane. The basic structure is of laminated spruce, the fuselage being a built-up box and the wings having two main spars. Balsa is extensively used in the secondary structure, and the skin is nylon. Leading edges are skinned in balsa, and the low flight speed and R (0.7×10^6) minimizes the effect of waviness and roughness and makes a laminar wing practicable. Using Prof Richard's china-clay method, a two-dimensional model has achieved laminar flow up to 60 per cent chord.

As a photograph shows, the nose fairing is detachable. Behind it is the "bicycle" and propeller pylon, which are fabricated in light-alloy tubing (argon-arc welding was excellently done by Moor Green Industries). During early taxying trials the front part of the frame deflected under load, and the present design is fabricated in light-alloy sheet built up into a box structure. Trouble was also experienced with the nosewheel; the original 14in pneumatic-tyred wheel was initially replaced by a tiny 3in wheel on a castoring mounting, and the final pattern is a light-alloy sheet unit in a castoring levered suspension.

A second aircraft which has been designed and built with an eye on the Kremer Prize is likely to be unveiled in the near future. This is the product of the Hatfield Manpowered Aircraft Club, who have to date declined to disclose any details of their design. It is believed to have a span similar to the Southampton aircraft, but to weigh appreciably less—a factor which would doubtless assist while the craft was airborne but could lead to severe problems in gusts, or on the ground and while landing.



On Thursday, November 9, Derek Piggott became airborne on three test runs at Lasham. On the first (above) he made three hops, to a maximum height of about 3ft; on the second he made another short hop; and on the third he achieved an estimated height of 5ft and distance of 50-70yd (pilot's estimates). Below, the beginning of an earlier run along the Lasham runway

Short-haul Jetliners

By the Technical Editor

A ROUND-UP OF TYPES PROJECTED OR ON OFFER

AT the end of World War II an official assessment by the RAE concluded that turbojets would be suitable only for short-haul airliners: medium-range equipment would have turbo-props, it was said, and long-range operations demanded diesel or compound engines like the defunct Nomad. In practice, of course, the jet era came about by the widespread introduction of long-range aircraft, so that today it is the jet that is doing the transatlantic and transcontinental work and the propeller that still rules in local-service operation.

But the Caravelle, which many declined to take seriously until about three years ago, can now be seen to be a progenitor of a new family of short-haul machines which promise eventually to eliminate the propeller from passenger travel. (In this context we should also mention the Bristol 200, which, although never built, would have been even closer to the type of aircraft now being considered.) The reasons for the blossoming of the short-haul jet are varied. In some cases, notably in the USA, quality competition on major routes is sufficiently acute to demand such aircraft, almost irrespective of operating economics; but steady advance in gas turbines has led to turbofan engines so efficient that 500 m.p.h. transports can now be designed with the same fuel cost per mile as the best 300 m.p.h. aircraft of the same size designed in the 1945-50 era.

Today the short-haul jet is being keenly scrutinized by constructors and operators alike. Many manufacturers are busily drawing such aircraft and studying the reactions of possible customers, while the customers are either wistfully turning away, countering the salesmen by putting forward their own draft specification or—increasingly—signing on the dotted line. In very broad terms the market can be divided into "the US" and "the rest." The United States local-service operators are not able to assess the situation entirely clearly in view of the general reorganization of both carriers and routes; but in spite of this handicap it is here that the largest market lies for this class of aeroplane. The market is a relatively well-known quantity; what is less conclusive is the size of aircraft needed. In the rest of the world conditions vary so widely that it is impossible to say whether, in the next five years, non-US airlines will buy 50 small jets or 500. But sales here will come in "penny packets," making the manufacturer's task more difficult still.

Altogether the potential market for short-haul jets is vast: it could be argued that such aircraft will eventually replace every piston-engined Convair and Martin, every F-27 and Viscount, most Constellations and DC-6s and many DC-3s. Allowing for the difference in work-capacity, this still suggests eventual sales of, perhaps, 500 aircraft. On the other hand, it is only necessary to reflect on the financial position of most carriers today, and on the fact that most of them are trying to off-load surplus capacity, to conclude that selling even 100 small jets will take time. What is no longer in dispute is that such aircraft are highly desirable; it has always been agreed that they would offer a swifter, more comfortable ride, and would lure traffic away from competitors; but only in the past two or three years have new engines made the small jet at least as efficient (on a direct operating cost basis) as a propeller aircraft.

This d.o.c. argument can, of course, serve as an example of how one can present statistics which, although mathematically correct, lead the unwary to incorrect conclusions. For example, a half-full DC-6B is less profitable than a full Comet, even though the former—with its capital cost almost written off the books—may appear a desirable vehicle. The effects of fare-fixing, pooling and other artificial rules governing operating revenue do not exert anything like as great an influence upon the equipment chosen as do such factors as the promised performance (including the ability to operate out of a given difficult field on a hot day with full payload); the size of the vehicle (which must be correct for anticipated traffic); the "saleability" of the aircraft by travel agents (which depends upon its name and appearance, as well as upon trumped-up promotional material); and, by no means least, the reputation of the maker of the airframe and engines.

There follow brief notes on some major manufacturers now eying the field. Of the new projects mentioned, only one is known to be the subject of a firm programme. This is the BAC One-Eleven, with Rolls-Royce engines; and if ever any aeroplane looked like coming home a winner it is this.

PROJECTS AND PROSPECTS

Avro This company have produced a series of short- and medium-range studies, of which the last to be publicized was the 771, powered by two Bristol Siddeley BS.75 turbofans. This has not yet been proceeded with: presumably Hawker Siddeley Aviation have to decide whether to go ahead on this design, or the D.H.126, or neither.

Boeing Although it takes a great deal of work to keep 91,000 people gainfully occupied, the Boeing Company—and especially their Transport Division—have all that they can manage for the moment. The unparalleled success of the 707/720 family, and the series of huge contracts which have launched the 727, ensure that there will be no "bathtub" on the shop-floor until at least 1965. But president Bill Allen is notorious for his caution, and in planning more than three years ahead the company would undoubtedly like their short-hauler to move out of the project stage and into hardware. Designated Boeing 737, it is at present still a "rubber airplane" which can be stretched and contracted to meet the needs of the best customer. Pratt & Whitney are almost certain to be chosen to make the engine, although no such powerplant exists outside Bristol Siddeley's works at Patchway. The 737 is at least an entirely new aircraft, incorporating 707 experience but few 707 components; although three-engine versions have been studied, it is most likely to have two engines.

BAC-107 This was one of the first of all short-haul jets, being born in the design office of Hunting Aircraft at Luton in may 1956. Originally it was to have been powered by two Orpheus turbojets, and its economics were not inspiring. The projected BE.61 turbofan was substituted, and the design finally wound up with the carefully optimized BS.75. When Hunting became a subsidiary of British Aircraft Corporation the H-107 design was deemed good enough for acceptance as a group project—the BAC-107. After being probed and developed at Weybridge the design served as the basis for the BAC One-Eleven, discussed below, which differs considerably from the original 107 design. The next step was to turn the wheel full circle by producing a lighter version of the One-Eleven for carriers with a route-structure and traffic better suited to a 48,500lb twin-BS.75 aircraft. The latest idea is that the 107 would have an airframe similar to the One-Eleven, apart from a slightly shorter fuselage, thinner skin gauges, and reduced fuel capacity—the first time, we believe, that the process of "shrinking" has been applied so drastically, the only previous example being the Boeing 720. It is certain that there are airlines to whom the BAC-107 is more attractive than the One-Eleven; but when it comes to the test there is little doubt that most carriers will buy the aeroplane offered. This leads the impartial observer to conclude that British Aircraft Corporation may let the 107 die a natural death; it has at least brought the One-Eleven into the world. One factor which might cause the BAC board to think again would be the emergence of an immediate rival in the 107 category, which is not unlikely.

BAC One-Eleven This aeroplane (two Rolls-Royce Spey engines of 10,400lb thrust each) has a weight of 68,250lb—more in a projected version with a centre-section tank—and seats up to about 70 passengers. Described in *Flight* for August 10, 1961, it was first announced in May, when 10 were bought by British United. Subsequently six (plus six on option) have been ordered by Braniff, the first instance of a foreign transport having been bought by a US carrier "off the drawing board." Virtually every major airline in the world has begun to assess the One-Eleven, and interest in the aircraft is hardening at an extraordinary rate. It is curious that so logical a successor to the Viscount should have come about by such a devious chain of events. [*Continued overleaf*

Short-haul Jetliners . . .

Convair General Dynamics have burnt their fingers so badly with the 880 and 990 that it is extremely doubtful that they will proceed with a small jet. Their present studies are twin-engined, and at quite a late date some still had nacelles hung below the wings.

de Havilland The D.H.121 Trident is in a larger, longer-ranged category than that here discussed. The D.H.126, however, appears to be a project for a small jetliner which has reached the stage of preliminary presentations to selected operators. It may well have replaced the twin-Gnome D.H.123 as a major transport project, although the company have made no announcement to this effect; in fact, the D.H.126 may well be inactive.

Douglas After years of project work the engineering department finalized the Model 2086 as the best possible short-range airliner. The design has never been publicly revealed, but it appears to be for a machine of some 70,000lb, with four wing-mounted engines now giving way to twin fuselage-hung Pratt & Whitney JTF-10s of 10,000lb thrust. The project has so far lain dormant, owing to the deal with Sud (to act as foster-parent to the Caravelle, and make the Caravelle if the market allowed) and to the need to fund continued DC-8 modification. Meanwhile, the aircraft side of the firm appears to be dying.

Fokker At the time of writing, the F-28 appears to be a paper project only, but the name of Fokker is such that it may well turn into a firm programme in spite of the company's vast burden of production work. The existence of such a project was revealed in the 1960 report of the NIV (government aircraft institute), who are keenly discussing the prospects of the aircraft with Fokker. Powered by two BS.75s, the F-28 is probably comparable in performance to the BAC-107, and is likely to stabilize at a weight of about 50,000lb.

Lockheed This company have both the skills and background necessary for such work, but appear to have no plans in this field. Whether this is in spite of, or because of, the Electra is hard to tell.

McDonnell Unsuccessful rival of Lockheed Georgia in the UCX competition, McDonnell Aircraft have since that time produced a largely new and rather larger twin-turbofan project designated T-85. This has been discussed with several airlines, but it does not appear a likely starter.

North American NASRT stands for North American short-range transport, and the huge company (California Division, it appears) have spent many months promoting a project which has yet to settle down. During the summer of this year it was powered by four developed versions of the 4,200lb General Electric CF-700 aft-fan engine, but NAA seem now to be convinced that only a twin will succeed. Weight would be about 72,000lb.

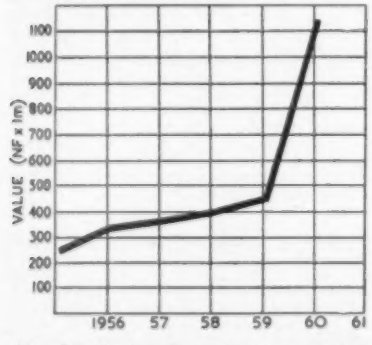
Sud-Aviation With 146 Caravelles on order, plus 43 options, Sud are embarking on a considered programme of development. Very little has been heard in recent months of the "Baby Caravelle" and Caravelle Junior. Rolls-Royce Spey engines and Hobson constant-speed drives for the latter were reported to be on order earlier this year, but Sud's increasing ties with British Aircraft Corporation may well involve agreement by the French company to leave this particular field to the BAC-One Elevens. Conceivably parts of the One-Eleven might be made by Sud. What is openly publicized are Sud's plans to stretch the existing Caravelle, and the 10A (20 already bought by TWA), 10B, 10C, 10D and 10F versions are all active projects. All will have a glove on the inner leading edge and a tailplane/fin bullet to raise the limiting Mach number from 0.77 to 0.81—a remarkable increment. Although the 10A now in production has the General Electric CJ-805-23C aft-fan engine of 16,100lb thrust, the other variants have the Rolls-Royce Avon 533, as in the earlier Caravelle 6, and the Pratt & Whitney JT-8D and projected Rolls-Royce RB.174 (openly discussed by Sud, the 174 is clearly a Spey-type engine sized to give about 15,000lb—i.e., a modernized RB.141). Sud are naming the 10A the Nouvelle Caravelle, and say that "the next series will be called Caravelle Horizon. The leading-edge gloves and other modifications for these aircraft are largely the work of Douglas Aircraft, under the terms of their licence agreement. Mention should also be made of the BAC/Sud supersonic airliner, which in its French form appears to be tailored for relatively short ranges, with only four (R-R or Bristol Siddeley) engines. But this M2.2 machine really comes into the short/medium category of the Trident and Boeing 727.

Tupolev It has not escaped the notice of most airlines that the Tu-124 is a turbofan short-hauler actually in being. Little is known of it beyond the brochure specification, but several good judges—including John L. Watkins, of TAA—have taken the trouble to inspect the aircraft at first hand. Examples have been flying some two years, and there are indications that its progress is satisfactory. Data were given in *Flight* for July 8 and 22, 1960.

METEORIC RISE OF FRANCE'S AIRCRAFT EXPORTS

THE table on the right and the graph below indicate the remarkable growth of French aircraft exports over recent years. To the details of construction by the major companies should also be added the not inconsiderable number of light aircraft exported by the smaller companies. The equipment and engine industries have contributed their quota, notably Turbomeca engines, produced in large numbers under the USA and Britain. Nord has additionally produced and exported scores of thousands of missiles.

Now being added to national production are the international programmes in which France is taking a major part, the Transall and the Breguet Atlantic, the space programme and other agreements now being finalized. In a type of industry which has tended to contract, France has done extremely well in building up an export business where none existed at the end of World War 2.



How French aircraft exports have climbed during the past five years. Total for the first six months of this year was NF753,883. The new franc is worth 13.4 to the pound

FRENCH AIRCRAFT EXPORTS AT OCTOBER 1, 1961

Manufacturer	Type	Export Orders	Licences	French Orders	Total Production Programme (inc. French orders)		
					France	Other	Total
Breguet	1050 Alizé	Secret No to one country	None	Secret	92	0	92
Dassault	Mirage III	Secret No to 3 countries	Australia, Switzerland	370	Secret	about 130	about 500
Morane-Saulnier	760 Paris	55 to 8 countries*	Argentina	44	129	36	165
Morane-Saulnier	880 Rallye-Club and 885 Super-Rallye	363 to 35 countries	None	167	1st batch 500	0	500
Nord-Aviation	Nord 2501 Noratlas	44 to 3 countries	Germany	220	264	161	425
Potez	CM 170 Magister	4 144 to 6 countries†	Germany Finland Israel	310	454	261	715
Sud-Aviation	SE. 210 Caravelle	101 to 12 countries‡ (+ 48 options)	None	43§	175	0	175
Sud-Aviation	SE. 3130 Alouette II	385 to 25 countries**	Sweden USA	395††	810	0	810

* Argentina, 48 (Licence including delivery of 12 major assemblies and 36 sub-assemblies); Brazil, 30; Germany, 2; Great Britain, 1; Iran, 1; Italy, 2; Morocco, 1; Switzerland, 1; USA, 4; Venezuela, 1.

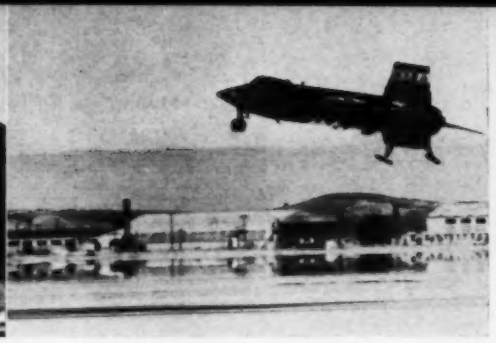
† Austria, 6; Belgium, 45; Cambodia, 4; Finland, 60 (23/37); Germany, 250 (of which 62 delivered by POTEZ); Israel, 40 (4/36).

‡ Aerolinas Argentina, 3(+ 3 options); Alitalia, 14; Finnair, 4 (+ 1); Iberia, 4 (+ 4); Royal Air Maroc, 2; Sabena, 8 (+ 2); SAS (Sweden, Norway, Denmark), 15 (+ 3); Swissair, 8 (leased from SAS, who ordered them); TWA, 20 (+ 15); UAL, 20 (+20); Varig, 2; General Electric, 1.

§ Air France, 35, of which some are operated under contract by Air Liban and Tunis Air; Air Algeria, 6; SGAC, 2.

** Argentina, 3; Austria, 9; Belgium 39; Cambodia, 2; Canada, 2; Congo, 3; Dominican Republic, 2; Germany, 205; Great Britain, 17; Iran, 1; Israel, 4; Italy, 1; Japan, 2; Laos, 2; Lebanon, 3; Morocco, 2; Netherlands, 12; Peru, 6; Portugal, 3; Sweden, 25; Switzerland, 10; Union of South Africa, 9; USA, 20; Venezuela: 1; Vietnam, 2.

†† 365 for military purposes + 30 for civil requirements in France and Algeria.



A record-speed flight by a North American X-15 research aircraft on November 9 is reported overleaf. These photographs show the aircraft about to land at Edwards AFB after an earlier flight; and the left-hand windscreen after the Oct 11 flight

Missiles and Spaceflight

MERCURY ORBIT DUE

A chimpanzee was scheduled to be the passenger in a NASA Mercury capsule due to be launched into orbit by Atlas booster in Mercury-Atlas shot MA-5 from Cape Canaveral in the near future. The three-orbit attempt was to give a test of all Mercury systems, particularly the capsule's environmental control system which will provide a "livable gaseous environment" for later manned flight.

The selected orbital path was at an inclination of 32° to the equator and an altitude of 100-150 miles, and flight duration was estimated at about 4½hr. Although the planned mission was for three orbits, the capsule could be commanded down at the end of the first or second orbit without compromising many of the flight objectives.

Descent after one orbit would bring the spacecraft down a short distance to the east of Bermuda, while termination after two orbits would mean touchdown several hundred miles south of Bermuda. After three orbits, the spacecraft would begin to enter the atmosphere over southern Florida and encounter a maximum 89 deceleration and 2,000°F re-entry heating at an altitude of about 37 miles, with touchdown occurring some 1,000 miles southeast of Cape Canaveral.

BIOS LAUNCH PLANNED

The effect of radiation and weightlessness on living matter was due to be investigated this week in a National Aeronautics and Space Administration launch of a recoverable capsule by means of a four-stage Argo D-8 rocket from Point Arguello, California. The flight was intended to pass through the inner Van Allen radiation belt to a height of about 1,165 miles, and to provide some 25min of zero-gravity conditions.

Named Bios (Biological Investigations of Space), the programme has as its scientific objectives "to discover the effect of radiation on a variety of small organisms, and to study how zero-gravity affects the growth rate of amœba cells, fertilization and cell division of sea urchin eggs and the production of microspheres." In addition, the spacecraft carries an experiment to chart radiation with respect to intensity, geographic location and magnetic fields, using a nuclear emulsion; and a micrometeroid experiment to record impacts of extra-terrestrial matter.

WORLD WEATHER-SATELLITE DISCUSSION

Synoptic meteorologists from 30 countries, including the Soviet Union, are attending the International Meteorological Satellite Workshop organized jointly by NASA and the US Department of Commerce Weather Bureau in Washington during November 13-22. At the opening of the meeting last Monday, NASA Administrator James E. Webb said "This meeting demonstrates anew that America intends to apply to practical use and to share with all the world the knowledge and skills we develop from our exploration of space. The countries attending here can now begin to equip themselves for the eventual direct use of our satellite information in their daily weather forecasting."

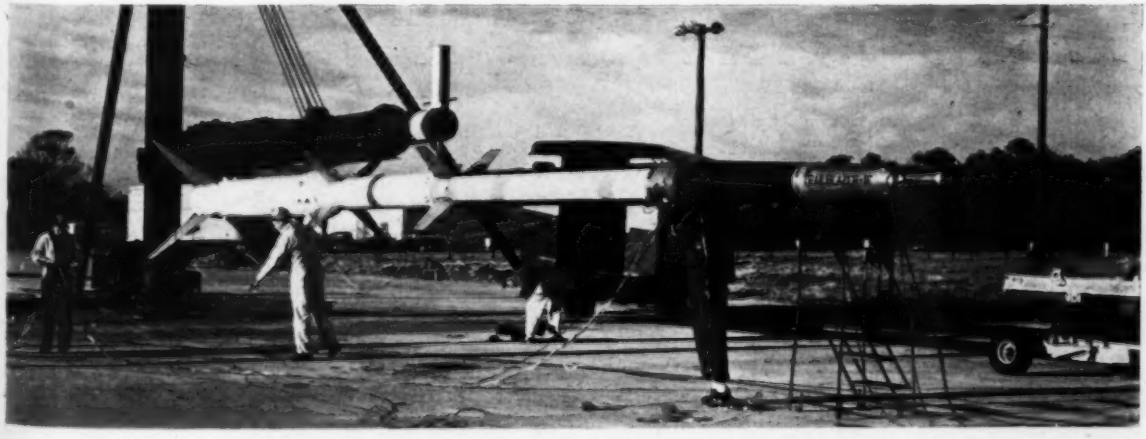
The Workshop programme includes lecture sessions on Tiros satellite engineering aspects, research results, data acquisition and future plans; practical laboratory sessions in which the participants use Tiros pictures to prepare weather analyses; and visits to the Goddard Space Flight Center at Greenbelt (technical control centre, computing centre and satellite pre-flight testing) and at Annacostia (Tiros satellite and data displays, radiation experiment and Nimbus mock-up), Wallops Station (real-time Tiros data acquisition and meteorological sounding-rocket programme), and the Weather Bureau's meteorological satellite laboratory and national meteorological centre at Suitland, Maryland (communications installation national meteorological analysis centre, numerical weather-prediction unit and long-range forecast unit).

ATLAS FAILURE

The 100th Atlas booster to be launched was destroyed less than a minute after lift-off from Cape Canaveral on November 10 after it had deviated from its flight path, apparently out of control. In its nose cone the rocket was carrying a 70lb capsule, containing a 1½lb squirrel monkey named Goliath and a number of biological specimens, which was to have made a 5,000 mile flight down the Atlantic missile range in a test of the effects of weightlessness, high g forces and radiation.

The monkey was not strapped in position in the capsule but was able to move freely in a small container padded with nylon netting. A deceleration of up to 52g for 1sec or more during re-entry had been anticipated. The rocket was destroyed by a command signal from the range safety officer 30sec after becoming erratic in flight.

Trailblazer is the name of one of the many types of multi-stage rocket launched in research programmes from the Wallops Island launch site of the National Aeronautics and Space Administration's Wallops Station, Virginia. An illustrated report of the work and facilities of Wallops Station, based on a recent "Flight" visit, appears on pages 768-771



Missiles and Spaceflight . . .

SYNCOM DETAILS

Artist's impression of the Syncom communications satellite being developed and built by Hughes Aircraft Company for the National Aeronautics and Space Administration (Goddard Space Flight Center)

DEVELOPMENT work by the National Aeronautics and Space Administration and Hughes Aircraft Co will result in the first launch of an experimental civilian active-repeater communication satellite into a 24-hour synchronous orbit within the next 12 months. Design of the satellite, named Syncom, is now almost complete.

The satellite will be used to relay telephone and telegraph communications over "near-hemispheric" distances. Early versions will not have the ability to relay television signals. A NASA announcement on August 11, 1961, stated that the Hughes company would build at least three Syncom satellites under contract to Goddard Space Flight Center, and that the satellites would be launched by three-stage Delta vehicles. According to Hughes, the satellite design is based on a concept which has been under study and development by the company for the past two years.

The Syncom satellite consists basically of a cylindrical shell faced with solar cells, an electronics package, compressed nitrogen tanks and jets, an orbit injection rocket, ten small vernier control rockets, and structure. It is 28in in diameter, 25in long (excluding aerials) and weighs approximately 55lb (excluding the orbit-injection or apogee motor).

When the satellite reaches the 22,300 mile apogee of the trajectory into which it will be fired by the Delta vehicle, the solid-propellant apogee motor will be used to inject the satellite into a circular, near-synchronous orbit. The ten small vernier rockets will be used to correct further the final velocity. Two nitrogen jets will be employed to attain and maintain the required orientation and position. One jet is located on one end of the craft about 12in to one side, and exerts its thrust parallel to the spin axis, while the second is situated in the side of the cylinder, with thrust acting perpendicular to the spin axis. Solar-sensing cells on the side of the cylinder provide real-time information via telemetry from which necessary adjustments in orbiting and orienting the satellite will be made by command from the ground.

An array of 3,960 solar cells will be carried on the cylindrical shell to supply power, and to charge nickel-cadmium batteries which will power the instrumentation of the satellite when it is not in sunlight. The system is designed to give the craft a working lifetime of one year, supplying 20W of power at 27.5V. Duplicate telemetry and communication systems, including command systems, are carried, operating on a power of 2W.

There will be two aerial systems aboard Syncom. A slotted array aerial projecting from one end of the satellite will receive and transmit the telephone and telegraph communications, while telemetry will be transmitted via four whip aerials. Communications signals will be received by the satellite on 7,500Mc/s, amplified by a travelling wave tube, and re-transmitted to the ground on 1,850Mc/s.

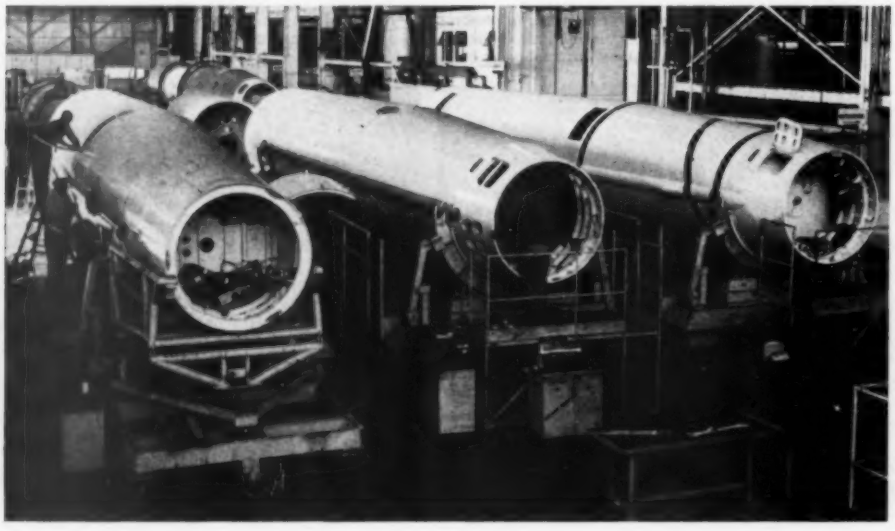
The satellite will be spin-stabilized in orbit, with the spin axis perpendicular to the orbital plane (and generally in a north-south direction in relation to the Earth). It will be placed in a 22,300 mile orbit synchronous with the rotation of the Earth. The first series of Syncom satellites will not appear to be stationary when viewed from the Earth, since the orbital inclination will be 33° to the equator and the satellite will appear to move between 33°N and 33°S.

The third stage of the Delta launch vehicle will carry the satellite to its orbital apogee and will spin it to approximately 160 r.p.m. The apogee rocket motor will then be ignited to provide the 4,850ft/sec velocity increment needed to inject the spacecraft into a near-circular synchronous orbit. The angular velocity of the satellite will be slightly less than the Earth's rotation, and the satellite will drift back westward to a specified longitude over the Atlantic Ocean.

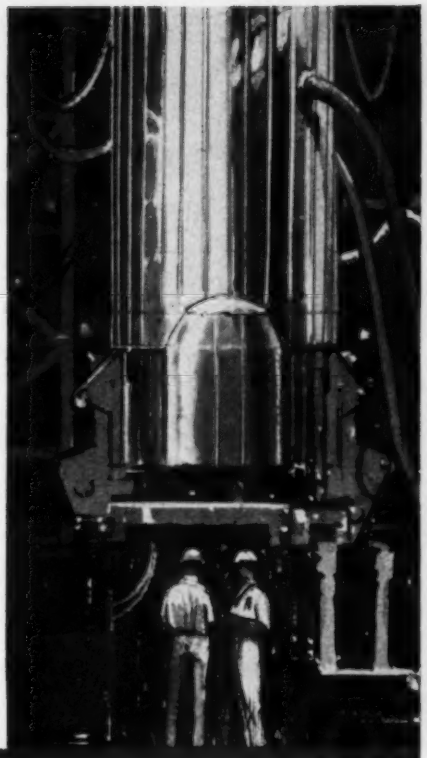
At this point a number of the ten small solid-propellant vernier rockets will be fired to achieve near-synchronism with the Earth at the desired longitude. Next the satellite will be oriented so that its spin axis is perpendicular to the orbital plane. This will be achieved by pulsing the nitrogen attitude-control jet in the base of the satellite by command from the ground, based on information about the craft's attitude and spin angle provided by a solar angle sensor.

Precise adjustment of the orbit will subsequently be made by pulsing the velocity-control jet on the side of the satellite. Both control jets can be employed throughout the life of the satellite to correct any changes in the orientation or orbit.

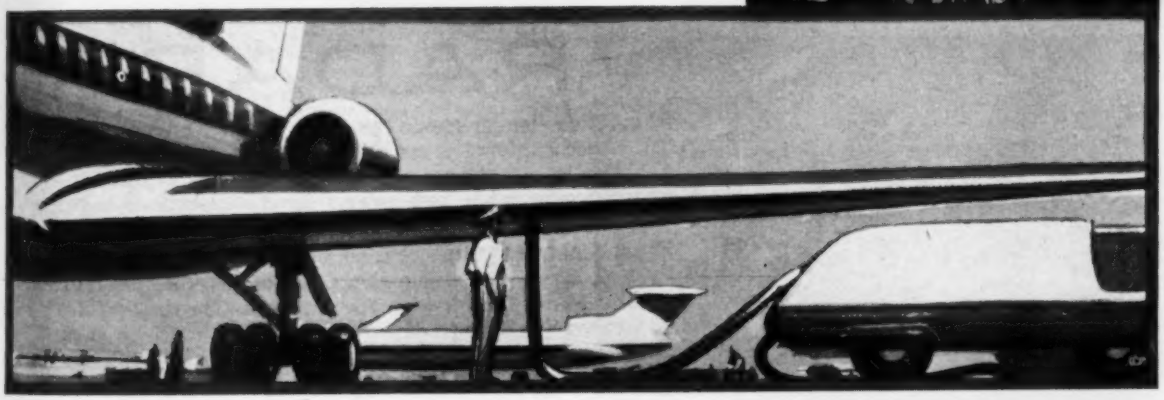
The Department of Defense is participating in NASA's Syncom project by providing Project Advent ground facilities, and the US Army's Advent Management Agency will conduct the communications experiments in co-operation with the space administration. Advent will be the first US military communications satellite designed for the 24-hour synchronous orbit.



Launch vehicle for the Syncom satellites will be the three-stage Delta, based on the Thor booster as first stage. This photograph shows Thors on the production line at the Santa Monica plant of the Douglas Aircraft Company's Missile and Space Systems Division. Of the three foreground vehicles, the one on the left is destined for a Delta launch by NASA, the centre booster will become a Thor-AbleStar for launching a US Navy Transit satellite, and the right-hand vehicle, when fitted with an Agena B second-stage, will account for yet another launch in the US Air Force's veteran Discoverer programme



Down go fuelling costs with the new A.W.E. fuel coupling



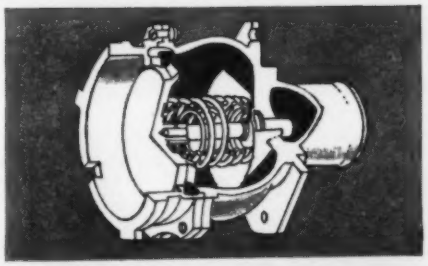
A new comprehensive range of aircraft mounted coupling units for aviation fuelling is now available ex stocks at A.W.E.

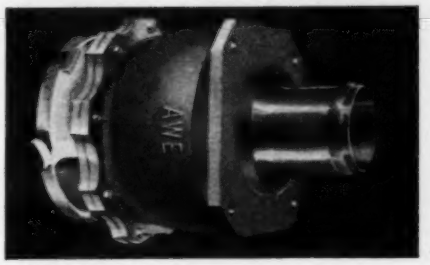
Combination of single seal and valve seat in the design reduces maintenance, spares holding, offers interchangeability of parts and provides a high degree of initial and operating economy.

The range comprises eight couplings with four types of outlets to each. Two sizes are available, either 1½ or 2½ inch outlets, all other parts being common to these. Special outlet connectors can be provided by arrangement.

Designed to Ministry of Aviation standards the couplings conform to International Standards Organisation and U.S. Military Standards requirements. The bayonet flange accommodates any of the approved kerosene or gasolene hose units.

A development of this design for handling H.T.P. is also available, complete with A.W.E. designed hose coupling.





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WHITWORTH GLOSTER AIRCRAFT LTD.,
MEMBER OF HAWKER SIDDELEY AVIATION.

RADAR

50 cm Gives longer range for given transmitter power.
The Marconi series of 50 cm radars gives clearance of jet aircraft from take-off to 150 miles plus on a power of only 500-600 kW. The one radar meets both airways surveillance and air traffic control requirements. Running costs are thus much lower.

50 cm Penetrates thick weather without loss of efficiency.
In most radars precipitation clutter seriously obscures the PPI picture. No remedial device is 100% efficient. The choice of the 50 cm wave length, however, avoids the difficulty entirely. It gives a clear picture of aircraft, even in heavy rain or snow, and also indicates the position of storm centres.

50 cm Permits M.T.I. elimination of permanent 'clutter'.
Of the various ways of clearing the echoes of stationary objects which confuse the interpretation of the radar situation, M.T.I. (moving target indication) undoubtedly gives the best results. The use of 50 cm makes it possible to use crystal control throughout a radar system to which a simple and completely stable M.T.I. can be harnessed to give a clear and unambiguous picture.

50 cm Switches into instant operation.
Crystal control of frequency enables Marconi 50 cm radar to be brought into instant operation even after long periods of inactivity.

GIVES THE LONG, CLEAR VIEW

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COMPLETE CIVIL, MILITARY AND NAVAL RADAR SYSTEMS

SURVEYED, PLANNED, INSTALLED, MAINTAINED

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The use of X-15 aircraft for launching Blue Scout rockets carrying satellites or deep space probes has been proposed jointly by Ford Aeronutronic and North American Aviation to various USAF Commands. First stage of this launching system would be a B-52 carrying the X-15. Launch of the Blue Scout as depicted would take place at a height of approximately 30 miles, the X-15 having been released from the B-52 at 50,000ft

Missiles and Spaceflight . . .

APOLLO CHOICE NEAR

The proposals made by five US companies and groups to develop and build the three-man Apollo spacecraft are currently being evaluated by the National Aeronautics and Space Administration prior to the award of the prime contract for the craft. The five contestants are:—

General Dynamics/Astronautics.
North American Aviation.
The Martin Company.
Team entry by General Electric, Grumman, Douglas and Space Technology Laboratories.
Team entry by McDonnell Aircraft, Chance Vought, Lockheed and Hughes.

Written bids were received by NASA by October 9, after which short presentations were made by each of the competing teams. Specialized panels of NASA Space Task Group personnel have since studied particular systems and aspects of the various proposals, and the results of these assessments have been passed to an overall source evaluation board. This board will produce an overall rating based on technical, management and cost factors, and will report to the NASA Administrator. The final announcement of the contract award is expected by the end of this month.

RENDEZVOUS WITH SAINT

In parallel with the National Aeronautics and Space Administration's work on developing orbital rendezvous techniques leading to refuelling and transfer operations, the US Defense Department is now attaching great importance to Project Saint, an Air Force development programme "oriented towards the problem of intercepting and identifying unco-operative satellites." Although the basic rendezvous applications, techniques and objectives of the two programmes are different, both will utilise some of the same engineering and scientific principles, and both agencies are therefore working together to ensure that there is a crossfeed of technology, and that advance planning towards possible applications and missions is unified.

Dr Harold Brown, Director of Defense Research and Engineering, Department of Defense, has stated:

"The Saint system is being developed because we believe that we must have the capability to inspect any unidentified space object to determine its characteristics, capabilities, or intent. We believe this might be done with unmanned satellites capable of manœuvring to intercept unidentified spacecraft.

"Such inspection involves the use of sensors such as television. Results from the Saint development flights will tell us the possibility of this approach. However, it is possible that, to perform the required mission, the use of more complex unmanned inspection schemes or manned inspection may be necessary.

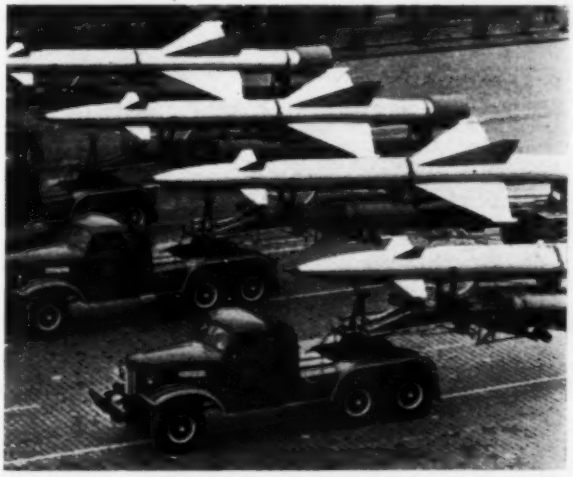
"In addition, there are many other potential military applications of the rendezvous technique such as logistics, maintenance, or transfer of manned crews, either as a routine or emergency measure. The NASA man-in-space programmes will provide the basis for evaluation and analysis of requirements."

VELA HOTEL PLANS

Initial experimental payloads in the Advanced Research Projects Agency's Vela Hotel project will be launched "piggyback" on planned launches by both NASA and the Defense Department. Later in the programme specific Vela Hotel launches will be made. The programme is designed to evaluate the effectiveness of a satellite system capable of detecting deep-space nuclear tests.

UTC PROPOSALS

Possible segmented-solid rocket projects proposed by United Technology Corporation include the P1-3, a three-segment, 60ft tall motor with a propellant weight of 240,000lb, developing 560,000lb thrust for 80sec; P1-5, a five-segment, 80ft tall motor with a propellant weight of 330,000lb, developing 1,000,000lb thrust for 80sec; and P1-10, a ten-segment, 180ft tall motor with a propellant weight of 880,000lb, developing some 2,000,000lb thrust for a period of 80sec.



Although no new guided weapons were seen in the parade through Red Square, Moscow, marking the 44th anniversary of the October revolution on November 7, these photographs are of superior quality to those obtained previously. The upper picture is a new angle on the 50-70 mile tactical missile carried, with launch crew, on a modified JS.3 chassis; on the right is the surface-to-air missile with forward-mounted controls which was first seen in 1959. A rear-control anti-aircraft missile was first seen two years earlier

A pre-launch picture at Cape Canaveral of the four-stage Scout used in the November 1 attempt to place a communications payload in orbit in order to test the Project Mercury tracking network. As reported last week, the launch attempt was unsuccessful

fully controlled by a human occupant (the man-carrying space capsules so far launched have been controllable only in attitude). During the descent one layer of the right-hand windscreen crazed, but the shattered panel remained in its frame (the same thing happened to the left windscreen on October 11). After landing back at Edwards AFB Maj White said that he expected the windscreen to be modified before altitudes greater than 250,000ft are attempted towards the end of this week.

Missiles and Spaceflight . . .

US MRBM FOR NATO?

Announcements by the US Department of Defense and Air Force on November 7 state that a study contract will be let for a medium-range ballistic missile intended for use by the European members of NATO. As might be expected, the weapon will have a solid propellant, and be intended for deployment on mobile launchers capable of being driven along any highway or reasonably firm ground. Range will be of the order of 1,000 miles. Use of strategic weapons of this nature appears to run contrary to the spirit of the original North Atlantic Charter, but there is American pressure to introduce them. Modifications of both Polaris and Pershing have been considered for this purpose, but the November 7 announcement implies an entirely new weapon. No contractor has been named.

X-15 NEAR LIMIT?

Since the inception of the programme, the design speed of the North American X-15 has been broadly given as "4,000 m.p.h." On November 9 Maj Robert White, USAF, flew one of these aircraft at a speed provisionally calculated at 4,093 m.p.h., at an altitude of between 90,000 and 100,000ft. This speed, which represents a Mach number of almost 6.2, is the greatest speed yet attained by a vehicle

HAWKER SIDDELEY SPACE RE-SHUFFLE

A reorganization of the astronautics group of Hawker Siddeley Aviation has been announced by the company. The group has been placed under the direction of Mr G. K. C. Pardoe, chief engineer (weapons and space research) of de Havilland Aircraft, and will be led by Mr Geoffrey Coates, assistant chief engineer (space research). Mr Coates is being transferred to de Havilland from the HSA advanced projects group. As reported in last week's issue, the former head of the astronautics group, Dr W. F. Hilton, was dismissed by Hawker Siddeley at the end of last month.

An HSA press release states: "Astronautics is now passing from the purely theoretical phase into one in which the practical engineering problems will form an increasingly large part of the programme . . . This reorganization will enable the practical background of a well-known guided weapons team to augment the facilities at the disposal of the astronautics group. The company will continue to give active support to the aims and objectives of the British Space Development Company."

Mr Pardoe

Mr Coates

The French National Assembly last month approved the establishment of a new French centre for space studies, to co-ordinate the work of all existing French space-research organizations.

A new small solid-fuel rocket motor, named Atmos, has been produced by the Aerospace and Defense Products Division of B. F. Goodrich. Designed as a booster and upper-stage propulsion unit for atmospheric sounding, Atmos is stated to be capable of carrying 8-12lb payloads to 300,000ft.

Next year's congress of the International Astronautical Federation will be held in Sofia, and Buenos Aires is in prospect for 1963. This was decided at plenary sessions at last month's IAF congress in Washington, when Prof J. Peres of France was elected president of the Federation in succession to Academician Leonid Sedov of the Soviet Union.

General Curtis LeMay, US Air Force Chief of Staff, said on October 26 that "tomorrow's space systems may use an altogether new kind of armament . . . war in the future may waged and decided without a weapon being applied against an Earth target." He said that the United States would be very naive if it did not "expect and prepare for" a war in space.

Aerojet-General and Rocketdyne have each received a ten-month contract from the National Aeronautics and Space Administration to investigate unconventional concepts of engine and vehicle design for a liquid-fuel rocket stage of 2m-24m lb thrust and weighing some 2,000 tons. Liquid oxygen/hydrocarbons and liquid oxygen/liquid hydrogen would be the propellants.

The National Aeronautics and Space Administration plans to acquire approximately 13,500 acres in south-west Mississipi as a static test facility for Saturn and Nova-class launch vehicles. The site is located in Pearl River county about 35 miles from NASA's Michoud plant in New Orleans where large booster stages will be manufactured for the Apollo and other programmes. Six or more test stands capable of handling boosters of 1.5m-20m lb thrust may be built.

An Aerobee 100 rocket was launched from the sea off Point Mugu, California, on October 25 by the US Navy. It was reported to have reached a height of about 5,000ft.

Fourteen Delta launch vehicles, incorporating DM-21 Thor boosters each generating 170,000lb thrust compared with the 150,000lb of the earlier DM-18 Thors, are to be built by Douglas for NASA under a $19m contract. This follows an earlier order for 12 Deltas.

US nuclear reactors for spacecraft are to be flight-tested in 1963-65, according to the chairman of the US Atomic Energy Commission, Mr Glenn Seaborg. The present schedule calls for flight tests of the 500W Snap-10A reactor by late 1963; the 3kW Snap-2 by 1964; and the 30kW Snap-8 by 1965.

The Italian Defence Minister has stated that Italy hopes to launch an Earth satellite in about 18 months' time, in co-operation with the USA. A Defence Ministry spokesman added that the launching would be from a platform built in international waters in the area between the Red Sea and the Arabian Sea. Cosmic-ray and meteorological experiments would be carried.

Cossor Radar & Electronics have supplied under MoA contract five aerials and associated synchronization equipment for the War Office trials establishment, guided weapons, Royal Artillery, at Ty Croes, Anglesey. The equipment comprises five circularly polarized helical aerials, operating in the regions of 100, 200 and 400 Mc/s, together with equipment for slaving them to the bearing and elevation readout from a master-tracking equipment.

The National Aeronautics and Space Administration has no requirement at present for an equatorial launch site. This was stated by Dr Arnold Frutkin, Director of International Programs of NASA, in Washington last month. Proposals for such sites had come to NASA from many countries situated on the Equator, he stated, but it seemed that the utility of equatorial sites had been grossly exaggerated. Even if an equatorial orbit were required—as, for example, in certain communication satellite applications—this could be achieved by "dog-leg" launches from Cape Canaveral.

The forecasting room on the seventh floor of the new Meteorological Office building. The room is air-conditioned. (See first news-item)

FLIGHT SYSTEM SURVEY

New Met Office Headquarters

METEOROLOGICAL work formerly carried out in buildings in London, Harrow and Dunstable has now been concentrated in a new £600,000 block built by the Ministry of Works just east of the new town of Bracknell, Berks. The handing-over ceremony took place on November 1 when the Parliamentary Secretary to the Ministry of Works presented an inscribed key to the Permanent Under Secretary of State at the Air Ministry.

Rising at its highest point to nine stories, the new building includes three blocks forming three sides of a square. The top floor of the highest block houses the weather forecasting branch in air-conditioned rooms with very large windows. This is one of the eight master analysis centres of the northern hemisphere and is responsible for forecasting weather developments over Europe and the eastern Atlantic. The office also provides guidance for all forecasting stations in the British Meteorological Service, both for ground level and high altitudes. Forecasts are prepared for the BBC, the national Press, public utilities and other bodies.

The eighth floor houses the communications centre where weather observations are received and transmitted by radio and landline to internationally agreed schedules. Teleprinters are connected directly to Canada, France, West Germany and Holland.

On the fifth floor is a Ferranti Mercury computer in a room screened with copper mesh and effectively earthed. The computer and laboratories on other floors are used for a wide variety of research programmes including several involving satellites. There is also a small printing press operated by HMSO for printing weather charts and forecasts, and two wind tunnels for testing meteorological equipment. The UK national library of meteorology is housed at ground level and includes weather records dating back to the 18th century or earlier.

150:1 Size Reduction

THE USAF Aeronautical Systems Division and Texas Instruments Inc, demonstrated a computer containing 587 digital circuits, each formed within a minute bar of silicon material, in a volume of only 6.3 cu in and a weight of 10oz. This provides electrical functions identical with those of a computer containing 8,500 conventional components and having a volume of 1,000 cu in and a weight of 480oz. The computer was developed as part of the Molecular Electronic Programme and was made by Texas Instruments as a practical application of semiconductor networks. The company claims that the computer demonstrated their ability to solve problems of interconnection, thermal dissipation, electrical interaction and maintenance of high-density packaging in complex equipment. Semiconductor networks allow considerable reduction in connections and individual packaging required for conventional components; and the network is formed by relatively few process steps, allowing a high degree of control and employing only very high purity material.

Texas Instruments Ltd in Bedford is co-operating with the American parent company in developing semiconductor networks. The British company is studying basic processes, semiconductor technology, the design of circuit networks, encapsulation and the application of the complete circuit in equipment and systems.

The GPS Terravision visual attachment for flight simulators is to come into use early next year for the Argosy C.1 simulator being installed at RAF Benson.

A complete public-address system for the ten Short Belfasts for the RAF has been ordered from Trix Electronics Ltd, a subsidiary of Ultra Electronics Ltd. The system will combine Trix and Ultra equipment and cost about £12,000. Deliveries will begin early next year.

Elliott-Automation Ltd have formed E-A Space and Advanced Military Systems Ltd as a parellel company to Elliott-Automation Systems Ltd in the non-industrial field. It is planned that the new company will play a large part in promoting British military and space systems for European and other foreign countries.

Amplivox now manufacture a new miniature encapsulated three-transistor amplifier with full MoA type approval. Designed for use with magnetic and noise-cancelling microphones, the amplifier weighs 2/3oz, has a voltage gain of 50db and contains a surge-limiting diode and output control. Component density is more than 300 per cu in.

A Redifon Action Speed Tactical Teacher which simulates naval exercises involving surface craft, submarines and aircraft was recently shipped in a Braathens SAFE DC-4 to Bergen for the Royal Norwegian Navy. The Royal Navy, RAN, RCN and USN already use Redifon Tactical Teachers.

Six complete Verdan airborne digital computers and six sets of components have been bought by Elliott Brothers (London) Ltd from Autonetics. There is a technical assistance agreement between the two companies. Delivery will be completed by March 1963; and Elliott will market Verdan to military users in Britain.

Two modified B-57s are being used in Germany to simulate the flight of Martin Mace air-breathing surface-to-surface missiles for training purposes. The B-57s carry the Atran (Automatic Terrain Recognition and Navigation) radar and fly the course that would have been followed by the Mace after practice alignment and count-down. Atran apparently involves the comparison of the actual radar mapping picture with prepared film of the track to be flown.

Racal Instruments announce their new SA.512 40Mc/s divider unit for direct measurement of frequencies up to 40Mc/s in conjunction with the Racal digital frequency meter SA.505 or other meters with standard decade time-base settings. The SA.512 is fully transistorized, is housed in a bench-mounting cabinet and takes its power supply from the SA.505.

Development of the Time Division Data Link for the USAF is now reported complete. Nicknamed Tiddles, the system can transmit from an air-defence computer interception instructions to several hundred intercepters, in some cases controlling the autopilot in the aircraft. A central interception computer is connected to numerous dispersed transmitters and the aircraft carry decoding receivers.

British Standard Code of Practice CP 1012: 1961, now issued, deals with the abatement and measurement of radio interference from electrical installations in civil aircraft. The code was prepared at the request of the IEE Committee on Radio Equipment for Civil Aircraft, who prepared Radio CARS for the ARB. It includes a new technique, which may become standard, whereby interference is measured at the receiver end of the aerial feeder terminals. Appropriate limits are also recommended. Copies, price 10s, are obtainable from the British Standards Institution Sales Branch, 2 Park Street, London W1.

Another section of the new Meteorological Office building: the teleprinter room, where hourly observations are received from NW Europe and the eastern Atlantic and retransmitted by radio and landline

Stress in the Air

AIR CDRE W. K. STEWART DISCUSSES VARIOUS PHYSIOLOGICAL AND PSYCHOLOGICAL FACTORS

THAT there is a great deal still to be learned about the relationship of human behaviour to stress was pointed out by Air Cdre W. K. Stewart in a recent lecture to the Guild of Air Pilots and Air Navigators. Air Cdre Stewart, CBE, AFC, BSC, CHB, is Officer Commanding the RAF Institute of Aviation Medicine and Consultant in Aviation Physiology, RAF. The subject of his paper was *Stress and Human Performance*.

It was extremely difficult to define "stress," said the lecturer, but "performance" did not require definition other than that it was generally held to denote behaviour which could be measured objectively. Stress, in the human context, usually meant strain on a bodily organ or mental power, with consequent belief in a breaking strain. One kind of stress was induced by physical environment; the other by internal bodily mechanisms.

Stress was most commonly induced both by changes in environment and task. It was often nebulous in character and might sometimes be confused with an individual's mode of living. Thus it might be extremely difficult to define or demonstrate a breaking point.

Exposure to stress might or might not produce objective signs of a change in bodily organs or systems, giving rise to the question whether it was normal and transient or abnormal and permanent. The problem might be easy where a fit young subject had daily experimented on criteria for physical fitness, performing a standard exercise. On the fourth day his pulse rates would be significantly different from normal, because of a change in his normal mode of living on the previous evening. This could not be called stress, because the reaction was not permanent, nor was the subject called upon to perform any task, exercise, judgment or trained skill during the impairment of function; nor was the change in behaviour permanent. But the problem might be difficult where there was some inherent predisposition towards permanency in change of behaviour; by exposure to stress of an abnormal nature; or through the nature of a man's flying task being continuously at the limits of his skill or endurance, without his being given sufficient time to recover between significant happenings. This was illustrated in the following case history of interaction between many factors.

Fighter Pilot Case History

A pilot (28) with 1,800 hours' experience was with an all-weather fighter squadron when he reported disorientating experiences. An acknowledged good pilot, regularly flying sorties of up to one-and-a-half hours' duration, he complained of illusions: of rolling and turning to the right when in straight and level flight. The illusion, experienced during initial training, was transient. But for three months before he reported, the illusions had become frequent and of longer duration, and impairment of his ability to control the aircraft had progressed so much that it occurred whilst he was taxying in poor visibility. Associated with the illusion was such a general increase in muscle tension that, when unable to suppress it, he had to pull his fingers off the control column with the other hand. A vicious circle of increasing tenseness led to loss of ability without the occurrence of illusions. Additionally, there were anxieties of a domestic nature.

On examination, he evinced a physiological abnormality in an asymmetrical response to rotation about both the rolling and yawing axes, evidenced in the movement of the eyes following an input of angular acceleration to his balancing organs in the inner ears. Tests also showed increases in the electrical activity of muscles, with an entirely different pattern to normal subjects. This pilot had a physiological disability giving rise to illusions when he was tired and anxious about non-flying matters, producing stress which might, in turn, have produced permanent changes in those parts of his bodily and mental systems which normally affected recovery.

The trigger or disability might be related to disease or pathology, as in the case of an experienced pilot who had originally been told by his instructor that he hyperventilated and should regulate his breathing. His fixation on this was marked so that when he reported headaches, and difficulty of focusing his instruments in flight, he was suspected of hyperventilation. Examination, however, revealed chronic infection of his sinuses on one side, and this was the primary cause of the symptoms and, indirectly, anxiety.

Thus practical cases of flying personnel exhibiting reactions due to stress concerned with flying, to the sociological life of flying as an occupation, and to such extraneous factors as personal and domestic worries, illness and loss of remuneration, were difficult to assess and were commonly assessed subjectively. But what was known objectively about their interactions on the body's functioning?

As a common denominator of all modern professional life, fatigue was not therefore solely applicable to the flight rôle. Severe deprivation of sleep was a major stress and of considerable importance both in many flying rôles and in ancillary ground posts. But surprisingly little was known about sleep and the effects of interruption of daily or diurnal rhythm. The average man usually had a sleep-wakefulness cycle or work-rest cycle in 24 hours; and by the time he had entered adult life his physiological and psychologically selected rhythms were so well established that it was difficult to determine which were innate and which acquired. Body temperature varied from 98°F at 1600hr to almost 97°F during sleep at 0400hr, and it was difficult to alter this as well as other related rhythms. Besides body rhythms there were changes in performance. Thus maximum speed and accuracy were usually found in the afternoon, with the minima early in the morning and late at night. But productivity study on the factory floor usually showed lower production in the afternoon. Whilst use was sometimes made of laboratory deductions, it should be remembered that motivation was often an uncontrollable factor.

Stress and the Time Factor

Life tended to be based on a working week rather than on a day, with physiological and psychological differences at the beginning and end of the week, and the application of this fact to flying was clear. Studies of four crews each flying 15hr sorties over an eight-day period showed a significant decrement in performance commencing with the third sortie. Therefore, in studying stress, interpreted as fatigue, it was essential to consider the most significant blocks of time. A complicating factor was any change in work-rest schedules in daily or weekly schedules.

Most people did not adjust quickly to a reversal of the cycle, i.e., to sudden night work; their body-temperature fluctuations might take time to shift or adapt. Thus, when their bodily processes would be following a normal pattern with a reduction in the output of hormones having a protective action against stress, some individuals did not respond as readily as others. Performance of RAF crews flying night sorties, when compared to day-time flying, and allowance being made for weather factors, showed a decrement.

It was difficult to interpret adequately such falls in performance, because usually there had been some deprivation of sleep which was greater in the former case, no matter what administrative precautions were taken. If extraneous factors like motion, noise and vibration rendered rest periods invalid, the average man requiring about eight hours' sleep would accumulate sleep debt. Of the five classified stages of depth of sleep, the deepest or fifth stage usually occurred during the first two to three hours. It was not known how effective the lighter stages, 3 to 1, were in restoring normality to bodily functions; but it was suspected they were less effective than Stage 5.

Effects of Sleeplessness

Nothing was really known, either, about the effectiveness of rest periods, particularly in the sitting position, although it was suspected they were less beneficial to crew members with greater responsibility than to those with less. Output of hormones or substances secreted from the ductless glands was greatest on awakening and dropped between 0800hr and noon. The rise beginning at 0400hr and corresponding to the lighter stages of sleep did not occur in sleeplessness. Sleeplessness would appear to be a common factor in the causing of stress, and its effect on behaviour varied from the occurrence of blocks or complete lapses in attention (if the subject was performing a monitoring task) to normal performance (if the situation demanded a high level of motivation, i.e., was a challenging one). In the latter category there was evidence that some price was paid by a higher level of activity of that part of the brain which could be called the pacemaker of behaviour, i.e., the stem of the brain which was responsible for setting the whole level of arousal of the computing portions. This was reflected in increased muscle tension throughout the body when performing any muscular task involving skilled mental control.

Nothing was known about how long compensation might be effective, but when deprivation of sleep became excessive the process of recovery might be prolonged, not only as shown by subjective statements, but also by electrical indications of the brain function; 48 hours might pass before such an index returned to normal.

Abnormalities in the physiological state might act as a trigger, as in the case of an experienced instructor who was leading a flight of cadets through cloud when he had his one and only experience of acute vertigo in the rolling plane. So strong was his illusion that he considered baling out, but after a further ascent, with clearance

STRESS IN THE AIR . . .

of his ears, this passed off. It was undoubtedly connected with 48 hours' sleep deprivation which had occurred immediately before.

"There has been too little actual work done on the nature of the recovery from the stressful situation as compared with the deterioration in performance during actual exposure," said Air Cdre Stewart, who went on to remark that a further factor which complicated study of the indeterminate stresses of flight was change in environmental time—"not too much is known about this factor, which would be of importance in very long supersonic flights as well as in probable future space travel."

The major characteristic of adaptation to either loss or gain in a 24hr cycle, continued the lecturer, was the great variation between individuals. These matters were related to the time-clocks of the brain which regulated behaviour and physiology with the aid of the hormone-producing organs. By the sixth day, some subjects who had lost two hours a day had adapted almost completely; others still retained their old 24hr rhythm. The latter had an entirely different excretory pattern, which might lead to disturbance of sleep.

"This is a complicating factor in any study of stress and fatigue in east-west routes, or *vice versa*. Nevertheless, there is sufficient data from north-south flights of long duration and from flights in local latitudes to make some assessment of the simple stresses of flying as an occupation. The quantitative physiological data agree considerably with data on accumulation of errors and decrement in mental qualities, such as anticipation, to give an adequate picture —but only one which would agree with the commonsense subjective feelings and sayings of the flying personnel themselves."

In long flights with a good standard of work and of a nature not involving too great a continued demand on skill and concentration, there were discernible decrements in performance of pilots and navigators after approximately eight hours and in radio operators or radar operators after a shorter time. Commanders of large military jet aircraft secreted much larger amounts of hormone substances than did other members of the crew. Again, when comparisons were made between turbojet and piston-engined aircraft it was found that pilots of the former almost always showed much greater response of a similar nature than did the latter. But such observations were of little practical value, since it was extremely difficult to correlate performance decrement in terms of safety or even to determine the level at which physiological indices represented dangerous fatigue. There were large individual variations; but with single-seat intercepter aircraft it had been demonstrated that the inexperienced man as a rule excreted more than did the experienced pilot under combat conditions.

Effects of Orbital Flight

Development of experience was not merely development and control of skill, but control of mental and brain functions which regulated body responses.

Tension, anticipation and a normal amount of anxiety was the normal and controlled response; and this was evident even in subjects who had had as much probing and individual selection as in the case of the American astronauts. From the rises in pulse and respiratory rates of Cdr Shepard in the few minutes before take-off, and from the data recorded during the entire 15min flight, it was seen that the tension had as great an effect as the physiological variables, due to the acceleration. But it was debatable how great a degree of stress was involved in the absence of other data and in view of the fact that his performance was unimpaired when compared to his scores on the Mercury simulator.

It was now known that Maj Titov felt unwell during his fifth orbit. The reasons were unknown, but it could be suspected that interaction between the two kinds of postures controlling or balancing organs in the inner ear was responsible. Under conditions of weightlessness, the dampening effect of one kind on the other would be altered, but it was puzzling how sleep was reported to cure this malaise—not that sleep might cure it, but that he should manage to fall asleep at the specific time. Whether this malaise was a reaction peculiar to Maj Titov or to one of the unheralded stresses of orbital flight the Russians had stated they intended to discover in the future. [A note on this appears in our Correspondence pages—Ed.]

The real importance to aviation of work in the selection of astronauts lay in the comparison of follow-up data with the selection and training methods used. It had usually been impossible to do this in the everyday business of the flight milieu; but it was known that if it were possible to achieve administratively it would be worthwhile adopting methods of selecting temperamental qualities. From 1943 to the end of the war experiments showed that if aircrew could be classified as having a predisposition to anxiety or inertness in the face of flight difficulties those showing such adverse tendencies were most often suspended in training, sustained more fatal accidents and more often became operational casualties.

Unfortunately, with large populations it was not really possible to employ selection methods against adverse behaviour under stress. For dealing with stress caused by physical changes the background was often more certain, and real use could be made of research data gained in simulated laboratory experiments or from flight.

Exposure to Ram Pressures

Breaking point could be demonstrated. Sudden exposure of the body to ram pressures of over 8lb/sq in caused high pressures in the unsupported veins of the eyes. Such an effect was not of any real medical importance in itself; but it might be accompanied by shock, which was of obvious importance if the subject had to escape at very high indicated air speed, as it could affect his mental competence for landing.

The important physiological effects of a rapid decompression from 8,000ft to 38,000ft, breathing air, could be observed as a rapid fall in the saturation of oxygen in the arterial blood reaching the brain after a delay, associated with a loss of carbon dioxide from the blood at the same time. From such data one could calculate the amount of oxygen available to the brain and also observe facets of behaviour if the supply of oxygen was too long delayed. Relatively long periods could elapse before the electrical activity of the brain and behaviour returned to normality following a restoration of oxygen.

In practice, many of the stressing agents did not occur singly; and then flight test, as distinct from laboratory test, was necessary to discover the more important of two stresses occurring simultaneously. In high-performance aircraft, under certain conditions, vibration or buffeting and rise in cockpit temperature occurred simultaneously.

In the laboratory one could deduce the effect of vibration on visual acuity or the effects of a rise in body temperature on human performance of a skilled task; but not even the greatest genius would care to decide from such data which was the most important to alleviate by practical means. Practical investigation in flight trials of the risks trained men would be prepared to take had quickly revealed that the rise in temperature was probably twice as important practically as vibration or buffeting, so long as the latter did not induce nausea.

"There is, then, a great deal still to be known on the relationship of behaviour to stress," said Air Cdre Stewart in conclusion. "This is obviously best done in the field by simple observations made by qualified observers. In some situations laboratory work is still urgently required; yet more deliberate experiments are required in flight, using modern methods of data finding and breakdown, because a characteristic of nearly all the experiments carried out to date is that only approximately 1 per cent of the data derived can really be regarded as significant to the accumulation of knowledge of the subject."

FORTHCOMING EVENTS

Nov 16 RAeS: Seventeenth British Commonwealth Lecture, "The Progress of BEA and of European Air Transport 1946-61," by Lord Douglas of Kirtleside.
Nov 17 RAeS Man-powered Aircraft Group: "Aerodynamics of Man-powered Aircraft," by T. R. F. Nonweiler.
Nov 17 Institute of Navigation: "The Navigation and Guidance of Supersonic Aircraft," by Capt William L. Polhemus.
Nov 17 Institute of Transport (Tees-side Section): "The Role of the Transport Helicopter," by Wg Cdr R. A. C. Brie.
Nov 21 RAeS: "Military Ground Effect Vehicles," by W. H. Coulthard.
Nov 22 RAeS Graduates' and Students' Section: "Army Aviation," by Col C. D. S. Kennedy.
Nov 22 British Interplanetary Society: Symposium on "Materials for Space Technology."
Nov 23 RAeS: "Flight Characteristics of the B-58," by B. A. Erickson.
Nov 24 RAeS Graduates' and Students' Section: Winter Dance.
Nov 27 RAeS Historical Group: "The Society's Library and Aeronautical History," by F. H. Smith.
Nov 29 Institute of Transport (West Middlesex Group): "A Pilot's View of Air Transport," by Capt O. P. Jones.
Nov 29 Society of Environmental Engineers: "The Response of Dynamic Systems to Shock Excitation," by B. H. Venning.
Dec 1 RAeS Rotorcraft Section: All-day Meeting.
Dec 2 British Interplanetary Society: "International Law Extra-terrestrially Applied," by Bin Cheng.
Dec 6 BritIRE (West Midlands Section): Conference on "New Electronic Techniques in Non-destructive Testing."
Dec 12 RAeS Astronautics and Guided Flight Section: "Military Requirements of Guided Missiles," by Brig E. W. Denison.
Dec 13 RAeS (Main lecture at Manchester Branch): "Airlines Approach to Aircraft Selection," M. Nivet.
Dec 13 RAeS Agricultural Aviation Group: Symposium on "The Uses of the Aeroplane in Agriculture."
Dec 13 Royal United Service Institution: "Some Reflections on the Strategic Air Offensive, 1939-45," by Dr Noble Frankland.
Dec 14 British Interplanetary Society: Symposium on "Auxiliary Power Generation."

RAeS Branch Fixtures (to Nov 23): Nov 17, *Luton*, Annual Dinner. Nov 22, *Glasgow*, "Conway Development," by L. G. Dawson.

Although detail modifications may well prove necessary before the first aircraft is completed, this artist's impression gives a clear indication of the big freighter's general appearance. Gross weight is the same as that of the long-range versions of the Boeing 707 and DC-8, but the C-141 will carry a much greater payload for any given range. Long-range cruising speed will be greater than 500 m.p.h. and field length barely 6,000ft

C-141

Lockheed's Heavy Jet Freighter

WORK is proceeding apace at the Lockheed-Georgia Company (a division of Lockheed Aircraft Corporation) on the C-141, already assured of substantial military procurement and now being increasingly promoted for commercial use under the designation Lockheed 300. This programme, and the subcontracts which will result, will be as important as any other project in keeping alive the manufacture of large aircraft in the United States after the end of next year. Today the eyes of the US Government and armed forces are looking through the atmosphere to interplanetary space, and it is a rare thing to find $1,000m voted for an entirely new military aeroplane.

Like RAF Transport Command, the US Military Air Transport Service is steadily increasing its airlift ability. Already colossal by any standard, it is being vastly reinforced by the procurement of large batches of Lockheed C-130E Airlifters and 30 Boeing C-135A Stratolifters; but neither of these types is regarded as an optimum vehicle and MATS are eagerly awaiting delivery of an entirely new heavy freighter drawn on a clean sheet of paper. Specific Operational Requirement 182 was finally drafted in August 1960, and outlined a specification for the aeroplane which has now emerged as the C-141. It is to replace all the "short-ranged" C-124, C-118, C-121 and like aircraft.

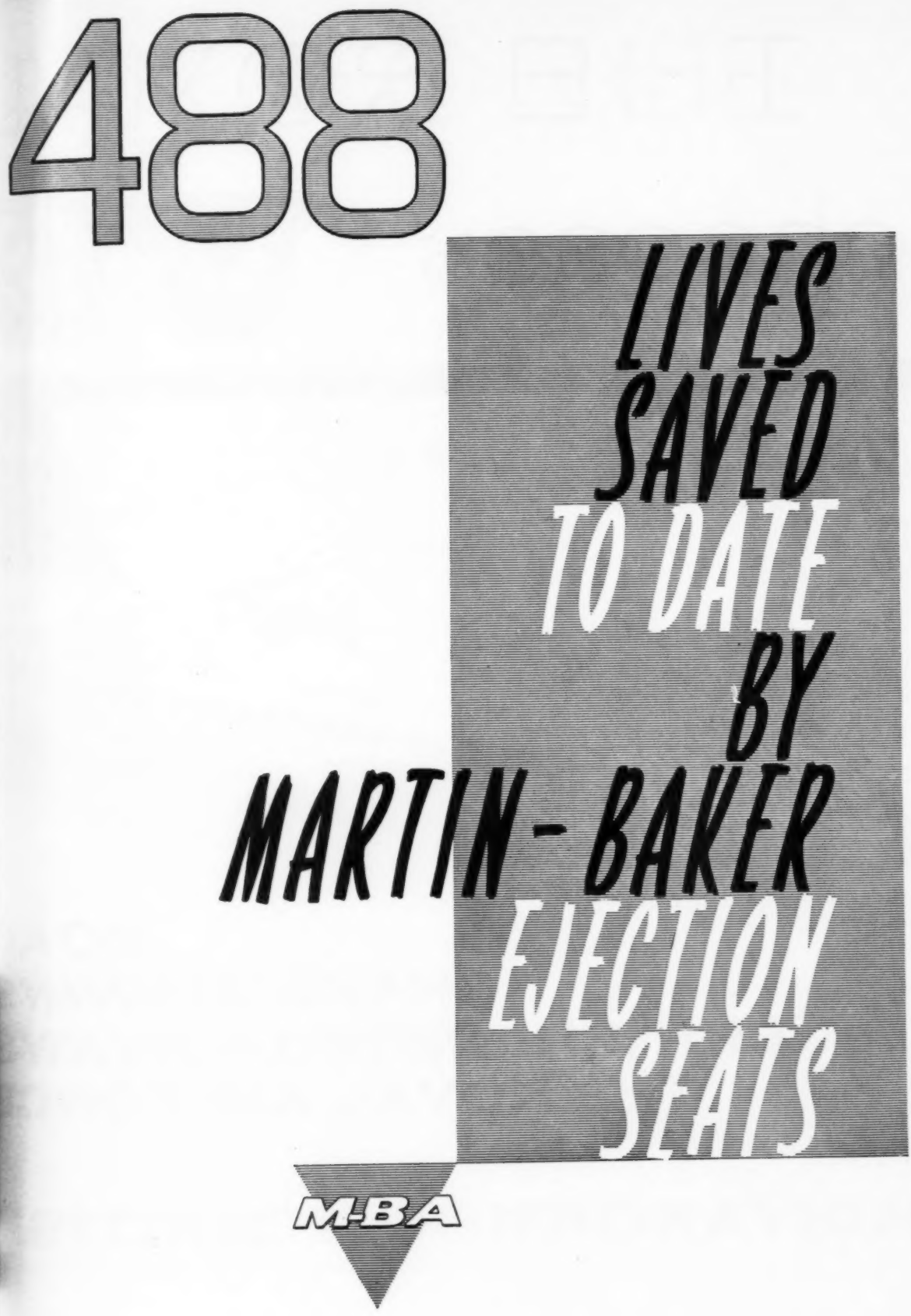
The US Air Force had previously conducted exhaustive and detailed investigations into future payloads (not only into weight and density, but also length, breadth and height), aircraft range, speed and field-length. These studies were related to the limitations imposed by US highways and railways, and it was also logical to work closely with the Federal Aviation Agency to ensure that the resulting aircraft would also qualify as a saleable product for civilian customers. Moreover, the weapon-system concept was applied from the outset, Support System 476 Logistic being the designation of the aircraft, ground-support equipment, loading pallets and related equipment.

SOR-182 called for an aircraft weighing 150 short tons, powered by four turbofan engines and capable of carrying 50,000lb cargo over "intercontinental" distances at a direct operating cost not greater than 5c/ton-mile. It was also stipulated that the freight hold should offer an unobstructed rectangular space not less than 70ft long, 10ft wide and 9ft high. The customer was also at pains to emphasize the philosophy which could lead to the sort of vehicle he wanted: every effort was to be made to produce a freighter which would be delivered on schedule, be easy to fly in arduous conditions, make no special demands on MATS bases and, above all, be completely reliable. No state-of-the-art advance was called for; MATS simply wanted a better truck for their global trucking job.

For years previously the Lockheed engineers at Marietta had been producing brochures on swept, jet-propelled derivatives of the Hercules, and it may have been partly due to this work that the company were the lowest bidder when tenders were demanded for SOR-182. The contract was placed on March 13 of this year, and not only did it lift Lockheed's stock-value by 5¼ points but it also severely depressed their rivals. At present it is possible that both Douglas and Convair may cease aircraft manufacture within a year, and either was in sore need of such a programme.

The same could be said of General Electric, whose Aircraft Gas Turbine Division at Evendale has been steadily contracting for five years. It was a bitter blow to them when the C-141 programme became yet another feather in the cap of Pratt & Whitney, who were chosen on March 20. The engine will be the JT3D-8A, with the military designation TF33-7, with a guaranteed thrust of 21,000lb and a corresponding s.f.c. of 0.605. Details of this engine were revealed on pages 93 and 96 of *Flight* for July 20. Compared with

After studying and rejecting a wide range of possibilities, Lockheed chose petal cargo doors (left). Port and starboard doors are each divided into upper and lower halves, the latter folding upwards through approximately 90° while the upper portions are opened outwards about vertical hinges at their forward ends. The flat pressure-bearing bulkhead then swings down to form the loading ramp. As shown below, this obviates the need for a wide rear fuselage and minimizes drag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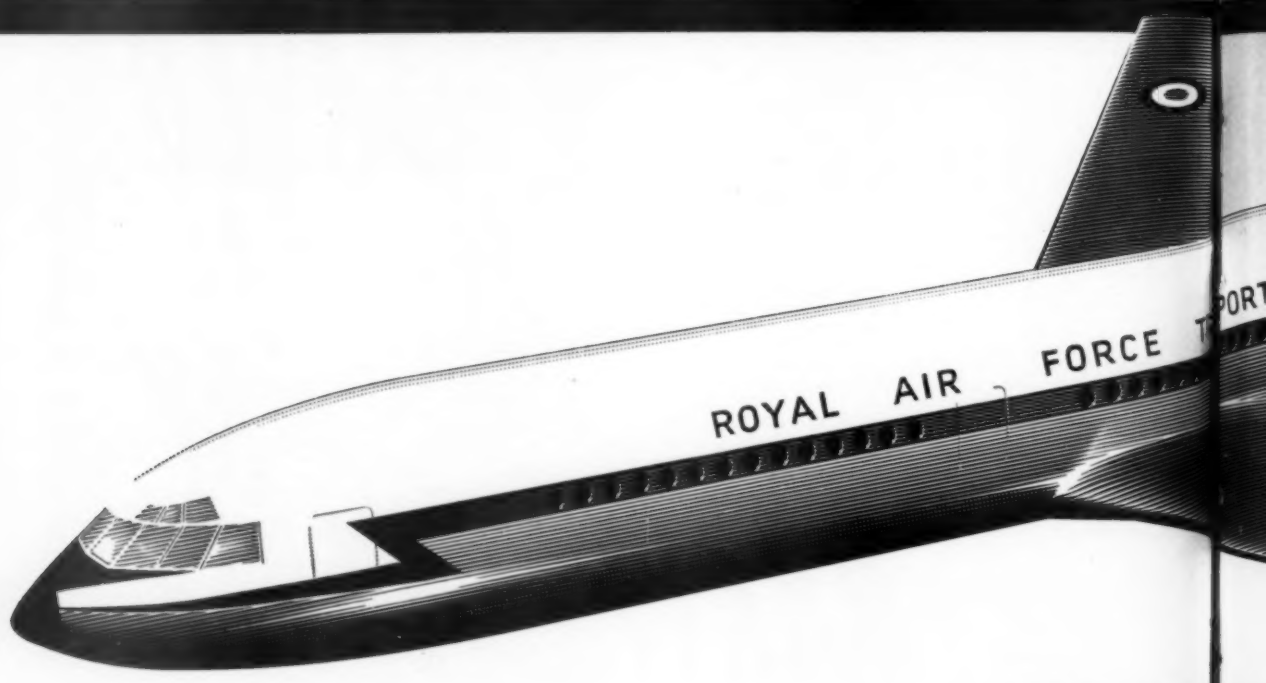
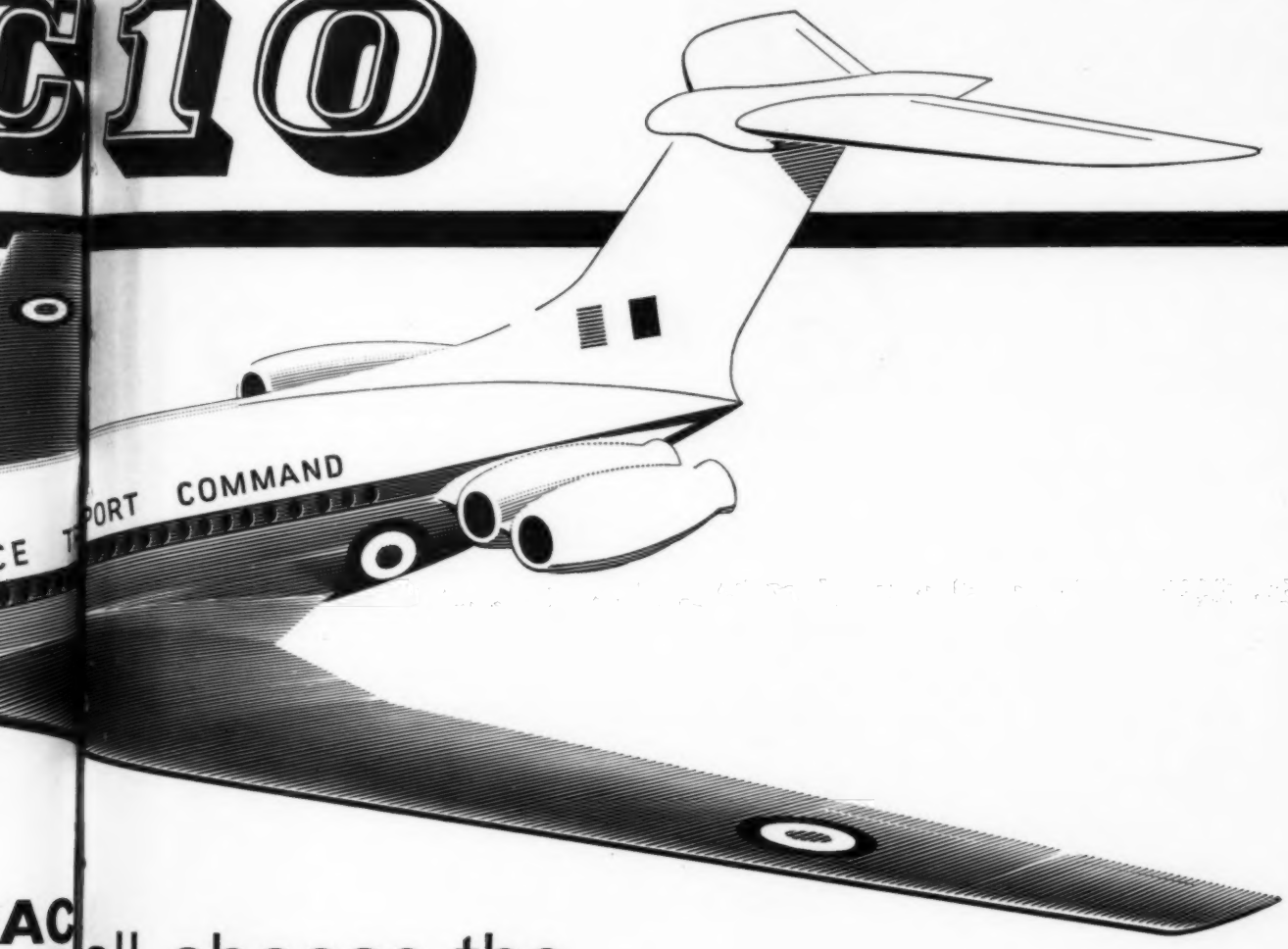


BOAC
GHANA AIRWAYS
BRITISH UNITED AIRWAYS
THE ROYAL AIR FORCE

BRITISH

AIR FORCE

C10



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C-141 . . .

earlier JT3D engines the -8A has an additional (or, rather, replaced) low-pressure compressor stage, and the bare dry weight is hoped to be held to 4,490lb. The first of these engines has been running for several weeks, and preliminary results suggest that it will meet its guarantees. Military qualification tests are scheduled for January 1963. All four engines will have reversers handling the whole mass flow.

As might be expected, there is practically nothing of the C-130 in the C-141, although Lockheed are naturally emphasizing the extent to which the proven features of the one will pave the way for the other. One of the most difficult areas to finalize was the rear fuselage and tail unit, and extensive tunnel testing (partly undertaken by Cornell Aeronautical Laboratory under an initial $375,000 contract) and mock-up trials led to the arrangement shown on page 762. The double-folding petal doors are hydraulically operated, and are relieved of pressure loads by the flat bulkhead which also serves as the loading ramp.

As in the C-130, the high-wing configuration and fuselage-mounted landing gear provide a truck-bed level cargo compartment. In flight, both cargo compartment and flight station are pressurized for an 8,000ft cabin altitude at 45,000ft, or a sea-level cabin up to 23,000ft. The cargo envelope is 109in high, 123.25in wide, and 90ft long, which allows a clear volume of 6,531 cu ft plus 625 cu ft on the ramp for a total of 7,156 cu ft. The Air Force loading system 463L is included as an integral part of the design, but its rollers and pallet restraining rails can be quickly retracted into recesses to provide a flat, smooth floor suitable for bulk loading, rolling stock, troops and litter patients.

LOCKHEED C141

(Four Pratt & Whitney TF33-7 turbofans of 21,000lb thrust each)

Dimensions: Span, 160ft 8¾in; length, 146ft 2¾in; height, 39ft 1in; gross wing area, 3,228 sq ft; leading-edge sweep, 25°; wheelbase, 53ft; track, 18ft 6in.

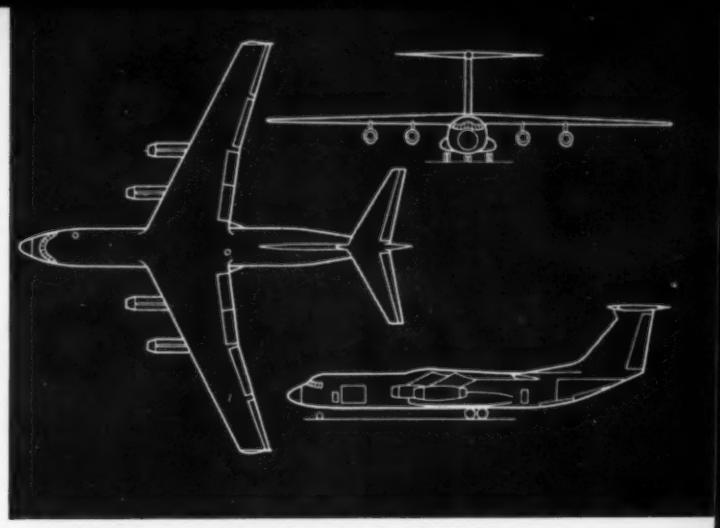
Weights: Empty equipped weight, 128,400lb; max payload, 93,000lb; max fuel, 150,000lb; max take-off, 315,000lb; max landing, 257,000lb.

Performance (estimated): Military distance to clear 50ft obstacle at max weight, standard day, sea-level, 5,300ft; max rate of climb, same conditions, 3,400ft/min; cruising speed, max 480kt (553 m.p.h.), long-range 440kt (507 m.p.h.); minimum flight speed for dropping, 115kt; range at 440kt with max fuel and 36,280lb cargo, 5,570 n.m.; range at 440kt with 80,000lb cargo and reduced fuel, 3,430 n.m.; ultimate ferry range, 6,560 n.m.; military landing over 50ft at max weight, standard day, sea-level, 3,500ft.

The floor structure contains 303 fittings for 10,000lb quick-disconnect tiedown rings on a 20in grid pattern, and 26 fittings for 25,000lb-capacity rings along the sides of the cargo compartment at intervals of 80in. The floor is capable of withstanding a load density of 300lb/sq ft, a crushing loading of 750lb/sq in and a 20,000lb-single-axle load along the treadway—remarkable figures. The cargo floor when converted to a flat floor will accept the rolling loads imposed by the 31,750lb MB-2 aircraft tow tractor. For aerial delivery, the forthcoming, 35,000lb armoured reconnaissance airborne assault vehicle can be dropped as a single load. Seating can be provided for 100-119 paratroops, or 102-151 infantry.

Lockheed found that the substantial benefits in flight characteristics and lifting ability which could be obtained by using a wing of only 25° sweep were offset by a penalty of only about 7kt in cruising speed, in comparison with 35° wings like those of the 707 family. The improved behaviour of the 25° wing is most marked during air-drops at below 200kt, at which speeds the large rear doors can be opened. There has been no attempt to incorporate flap-blowing or any other high-lift device apart from effective trailing-edge flaps. Nevertheless, field length is better than that of any other jet of comparable speed/payload/range performance, and is actually superior to that of much existing front-line MATS equipment today.

Lockheed-Georgia Co are now cutting metal on these big aircraft,



Provisional three-view drawing of Lockheed's C-141

and scarcely a day goes by without a conference with likely subcontractors. Only one major subcontract has been announced—engine pylons, awarded to Rohr—but Lockheed have to farm out 61 per cent of the airframe, according to the terms of their contract. At the time of writing it is believed that Lockheed have a signed contract for only five C-141 development aircraft, but the costing of the programme has been based on the declared requirement by MATS for 132. Fiscal years 1961 and 1962 respectively allowed $30m and $98m for the programme, and much more will come next year. Roll-out is due in August 1963, the first flight before January 1, 1964, and the first MATS squadron is to be equipped by June 30, 1965.

The Lockheed 300 is at present just an idea, which has had a mixed reception from the big freight operators. It would be strange if Lockheed did not vigorously promote the commercial counterpart of the C-141; but it is the type of aeroplane which demands a massive and sustained traffic if it is not to lose money. At about $5.5m (£1.95m), selling price should be rather less than that of the MATS machine, and removal of the heavy-dropping requirement and use of a lighter floor should cut the empty weight by at least a ton. Time will show whether or not the big jet freighter is a good idea for the airlines; but it is certainly a good idea for MATS.

In conclusion, it is instructive to evaluate the C-141 against comparable British aircraft. The table below gives salient data for the most important large transport aeroplanes developed for "Western" air forces. The point should be made that the Vickers-Armstrongs VC10, the largest, heaviest and most powerful aeroplane ever bought by the RAF, is primarily a passenger carrier. British Aircraft Corporation are offering swing-nose freight versions of both the standard and Super VC10, but the five aircraft at present on order for Transport Command are not to be of this type. For transporting large indivisible loads the RAF is buying the Belfast, and it is this aeroplane which must be compared with the C-141.

A study of the map suggests that British and American commitments demand strategically located reserves capable of being airlifted over similar distances, and one is left with the impression that the Belfast C.1 now being built should ideally have a greater range with full payload. Originally, of course, this aircraft was supposed to utilize parts of the Britannia in order to reduce development costs; and it is certain that at the time it was ordered the Air Ministry favoured turboprop power. In the event, Short Bros & Harland are developing the Belfast into a family of exceedingly capable heavy military and commercial freighters, which may in the course of time prove better vehicles for more customers than the possibly less flexible C-141.

MODERN MILITARY FREIGHTERS

Aircraft	Operator	Powerplants	Max cargo (lb)	Cruise speed (kt)	Hold dimensions		
					Length * (ft)	Width† (in)	Height (in)
Boeing C-135A	MATS	4 × J57-59W turbojets	89,000	460	86·5	132	84
Canadair CC-106 Yukon	RCAF	4 × Tyne 515 turboprops	60,480	330	98·6	137	81
Douglas C-133B	MATS	4 × T34-9W turboprops	91,279	281	97·3	168	159
Lockheed C-130E	MATS	4 × T56-7 turboprops	33,300	295	41·5	123	109
Lockheed C-141	MATS	4 × TF33-7 turbofans	93,000	440	70	123	109
Short Belfast	RAF	4 × Tyne 12 turboprops	85,000	320	63·3	194	165
Transall C-160	France/Germany	2 × Tyne 20 turboprops	31,000	270	42·7	124	118
Vickers-Armstrongs VC10	RAF	4 × Conway 42/1 turbofans	38,000	504	85·7	140	94
Whitworth Gloster AW.660	RAF	4 × Dart 101 turboprops	29,000	233	46.9	120	80

* Excluding space above rear loading doors, if applicable; †max internal.

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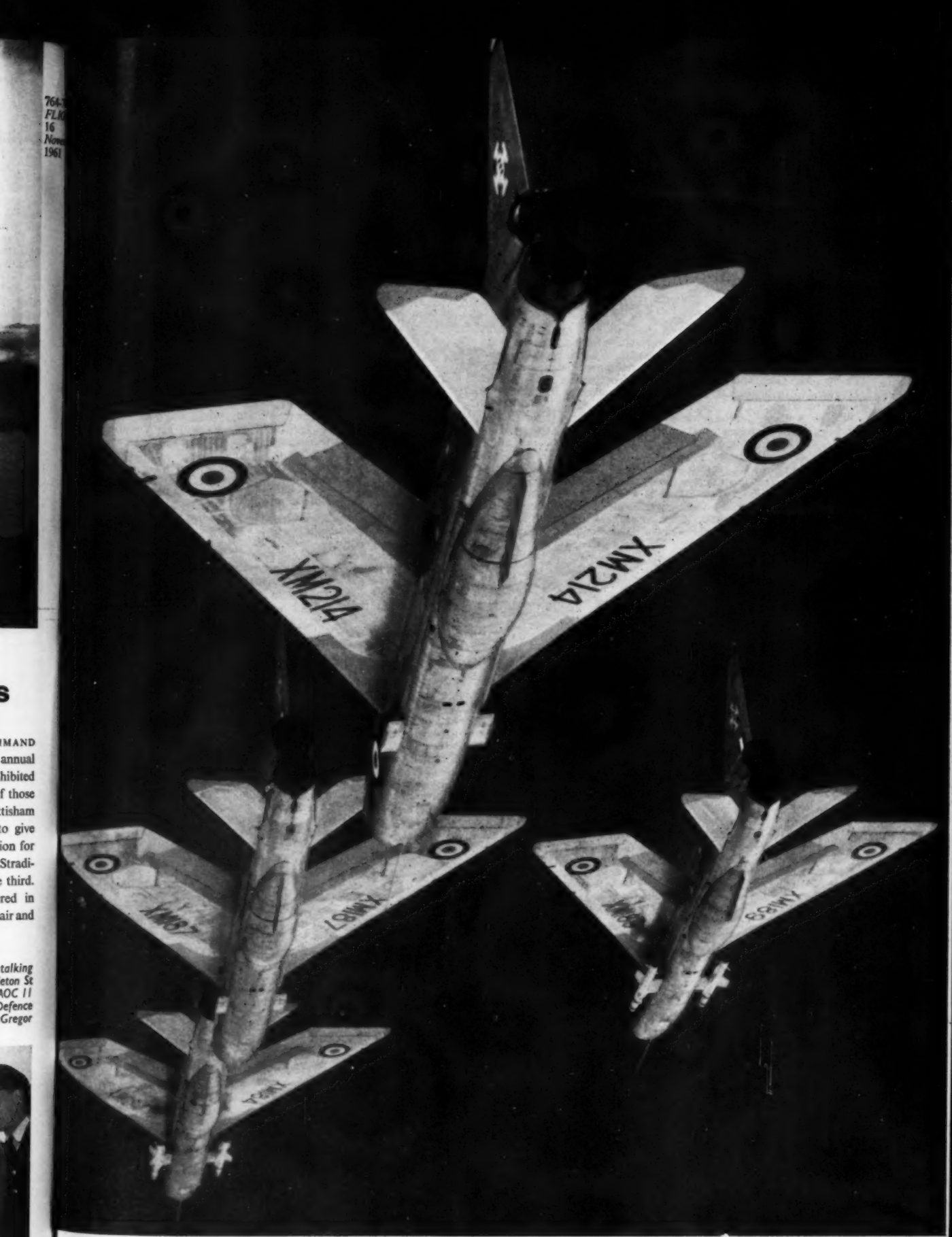
"TREBLE ONE—DUSK AEROBATICS" *Sgt N. Macfadyen, RAF Wattisham*

Fighter Command's Photographers

PHOTOGRAPHERS IN FIGHTER COMMAND recently participated in the command's annual competition, entries for which were exhibited at Stanmore. Shown here are some of those entries, including two from Wattisham (above and at right) which helped to give that station top place in the competition for the second year in succession. RAF Stradishall came second and Chivenor were third. Photographs shown here were entered in different classes—air-to-air, ground-to-air and public relations.

"Public Relations" (above) by LAC G. S. Borrett, RAF Wattisham, shows AVM R. N. Bateson, AOC 12 Group, talking to Sgt V. A. Dickson of Wattisham during the AOC's inspection; "Fishy Story" by SAC Aspinall of RAF Middleton St George shows Sqn Ldr R. R. Woodward, engineering officer of 33 Sqn, making a point to AVM H. J. Maguire, AOC 11 Group, and Wg Cdr D. L. Hughes, OC 33 Sqn; "Lt Admiral Pröpper" (below right) shows the Netherlands Chief of Defence Staff, Lt Admiral H. H. L. Pröpper, talking with the AOC-in-C Fighter Command, Air Marshal Sir Hector McGregor



"LIGHTNINGS" *Sgt N. Macfadyen, RAF Wattisham*

The Blue Angels

AN AEROBATIC TEAM THAT GOES THROUGH THE BOOK—AND BEYOND IT

AMONG the most spectacular and original aerobatic performances to be seen anywhere are those given by the US Navy's "Blue Angels" team. Here two American correspondents describe some of the team's training methods and—as seen at an event earlier this year—display manœuvres.

THROUGHOUT the day six navy-blue F11F Tigers with "Blue Angels" painted in gold across their noses had been parked near the static display. As the band played *Anchors Aweigh* Cdr Zeb Knott, USN, a veteran of the battles of the Philippines, Okinawa and Leyte Gulf led the five members of his team to their aircraft; the *pièce de resistance* of the show was about to start . . .

"Blue Angels" is the popular name for the United States Navy's Flight Demonstration Team, which was first formed in 1946. They are not a full-time aerobatic group but regular line pilots who are assigned a three-year tour of duty with the team. A new member of the team usually joins in November or December, just before the team deploys to a quiet area with good weather —such as Key West, Florida, or El Centro, California—for six weeks' training. The technique depends on the newcomer and his intended role. For example, in the case of a wing man, the leader takes him up alone and teaches him the techniques. When he is satisfied, the other wing man and the slot man [the pilot in the "box" of the vee—Ed.] complete the diamond formation, with the latter about two lengths behind. The slot man acts as a coach, and when the "bounce" of the new man is reduced to a two-foot maximum he moves up into his demonstration position. After six weeks' flying three times a day, seven days a week, the quartet is ready for work and the pilots are perfectly happy to keep their wings four feet apart when in the diamond or echelon formations. Because of the power changes involved, the rolls are the most difficult to master.

When a new member for the "duet" section of the team joins he is trained in much the same manner by the man he is to replace, the latter returning to the Fleet when he is satisfied that his replacement is up to par. Thus there is a continuous transition as one member returns to other fleet duties and a new man takes his place. Since the team was first formed, their types of Grumman-built aircraft have changed five times, starting with the F6F Hellcats, so they have always been flying front-line fighters. It is virtually tradition that one of the six is a Marine.

Collision-course manœuvres figure largely in the Blue Angels' repertoire. These two programme illustrations show (left) a rolling pass and (right) the "knife-edge," in which the two aircraft pass each other with wings vertical to the ground

The repertoire is not always the same, but on the occasion of the display which we were watching the foursome started with their usual opener, consisting of approaching one another at 90° angles at 7,500ft. Immediately after passing they rolled on their backs to split-S towards the ground, meeting in front of the reviewing stand and passing perilously close to one another at a height of approximately 50ft and at a speed of 500 m.p.h. Throughout the exhibition, coloured liquids were jettisoned from the outboard fuel tanks to accentuate certain manœuvres. The duet next entered on low-level 600 m.p.h. runs from opposite ends of the runway, pulled back their sticks, and climbed and rolled away out of sight.

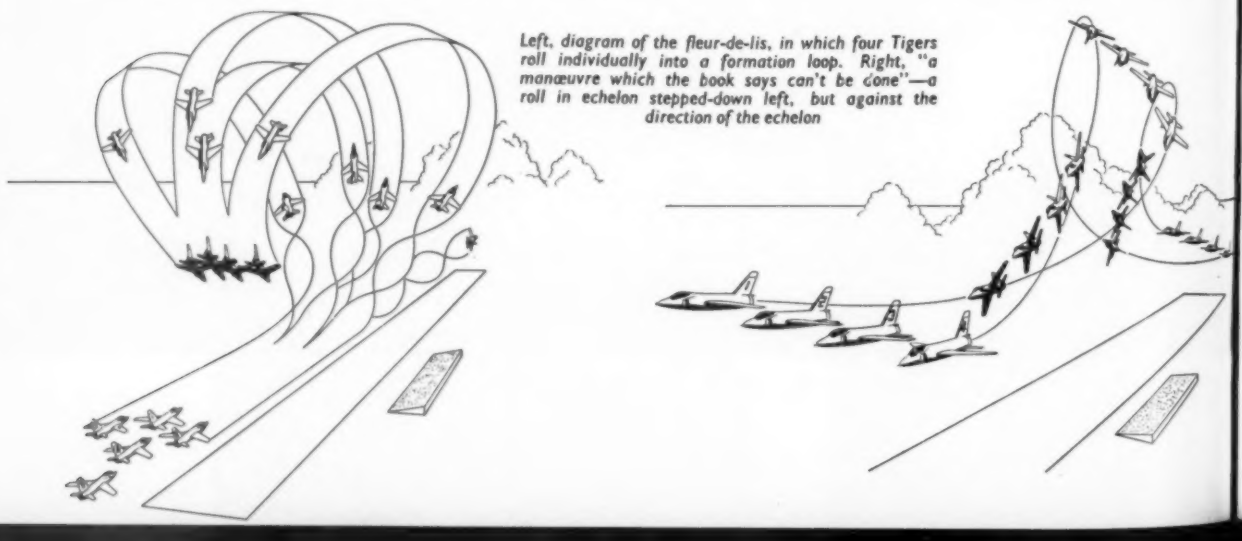
As one's eyes were still straining to see them disappear a roar from the left announced the return of the quartet to do a diamond roll, followed by a diamond loop of 6,000ft diameter. When they began their turn away from the field one of the duet was seen coming underneath them at 500 m.p.h. As he reached a third of the distance down the runway he began a series of horizontal rolls and at almost dead centre was passed by his companion, flying and rolling in the opposite direction. Meanwhile the quartet had formed echelon to the left and the whole team then rolled to the left in perfect formation. This manœuvre, more than any other, brought gasps from the crowd; and those even slightly knowledgeable about flying were left shaking their heads.

By the third shake of the head the duet had approached from opposite sides a few feet off the runway, risen a little as they approached each other, rolled through 90° till their cockpits were back to back, and passed with fifteen feet [Sic. Ed] between them, going horizontally in a gravity-defying act.

Next on the agenda was a reverse echelon roll, starting with the quartet in right echelon and finishing in left echelon. The precision, steadiness and apparent ease with which they performed this evolution were breathtaking. For their finale the duet fooled everyone by coming in from the same end. Suddenly one turned upside down and flew above his partner with the fins of the two aircraft offset by a few feet, a position which was held for a mile before they separated and one joined the quartet for a *fleur-de-lis* display. After all six, flying with flaps and wheels down, passed in a double vee they landed and taxied past a cheering crowd to the dispersal area.

J. A. BAILIE, W. G. WONKA

"At minimum altitude," says the programme, "one solo Blue Angel flies formation on the other, who is flying inverted"



Left, diagram of the fleur-de-lis, in which four Tigers roll individually into a formation loop. Right, "a manœuvre which the book says can't be done"—a roll in echelon stepped-down left, but against the direction of the echelon

Westland Belvederes and crews of 66 Sqn, commanded by Sqn Ldr H. R. Dowling, lined up at RAF Odiham, which is the squadron's base. Formation of this unit, the first in the RAF to be equipped with Belvederes, was described in "Flight" last week. Two more Belvedere squadrons are being formed in 38 Group

SERVICE AVIATION

Air Force, Naval and Army Flying News

Hovercraft Trials Unit

AN inter-Service Hovercraft Trials Unit is being established at HMS *Ariel*, Lee-on-Solent. Its purpose will be to provide information to assist in determining the possibility of using hovercraft for military purposes and also to formulate staff requirements.

Making this announcement, the Admiralty state that the Services and the Ministry of Aviation have been in close touch with hovercraft progress since Hovercraft Development Ltd and Westland Aircraft Ltd first demonstrated the SR-N1's ability to travel at high speed over both land and water. Future of the hovercraft in many military rôles, it is stated, will depend on the sea-keeping ability ultimately achieved. Preliminary studies and assessments indicate that there is good prospect that the seaworthiness of hovercraft can be developed to such an extent as to enable them to be used satisfactorily in Service operational conditions.

The nucleus of the trials unit has already been formed and the slipway and airfield at Lee-on-Solent are also being made available for use by experimental hovercraft constructed by industry.

Owned by Lt Mike Hornblower of 700Z Flight at RNAS Lossiemouth, this 1927 three-litre Bentley bears a numberplate particularly appropriate for a Blackburn Buccaneer unit

Senior Appointments

NEW posts have been announced for two officers who were Spitfire pilots in the Battle of Britain and who both subsequently commanded 54 Sqn. Air Cdre A. J. Leathart, CB, DSO, formerly Senior Air Staff Officer at 12 Group in Fighter Command has been appointed Director of Operational Requirements (C) at Air Ministry. Gp Capt F. D. S. Scott-Maldon, DSO, DFC, is to succeed Air Cdre Leathart as SASO at 12 Group from January 1 next year with the acting rank of air commodore. He has been Deputy Director, Air Plans (2) at Air Ministry for the past two years.

Helicopter Crews Complimented

CREWS of RAF helicopter air/sea rescue squadrons were complimented by the AOC 19 Group, Coastal Command, AVM L. W. C. Bower, at Manston recently, when he told officers and men: "Every time you save someone and carry out a spectacular operation you put the RAF in the front line of the news, both nationally and locally." In the last six months, 27 lives had been saved in 151 incidents. The flight at Manston had been called out on 21 occasions since it was based there at the beginning of the summer and had saved six lives.

Prompt Action

PRESENCE of mind in an emergency has led to the award of the Queen's Commendation for Brave Conduct to Cpl T. M. Lucas of RAF Colerne. Starting-up his vehicle after refuelling a Hastings, he found himself enveloped in flames. Instantly seizing a fire extinguisher and shouting for help, he got the severe petrol fire under control, thus undoubtedly saving both the aircraft and the refueller.

First of six Westland Gnome Whirlwinds for the RAF being handed over at Yeovil by the company's chairman and managing director, Mr E. C. Wheeldon. The helicopter was flown to Odiham by Flt Lt W. H. Johnson and has joined the Whirlwind Trials Unit there. No 225 Sqn is soon to be re-equipped with these helicopters

IN BRIEF

Aircraft of the Far East Air Force and RNZAF flew from Singapore recently with supplies for flood victims in South Vietnam.

The Royal Air Forces Association, 43 Grove Park Road, London W4, have published their diary for 1962. This contains, in addition to much other useful information, a full list of RAFA branches in the UK and overseas.

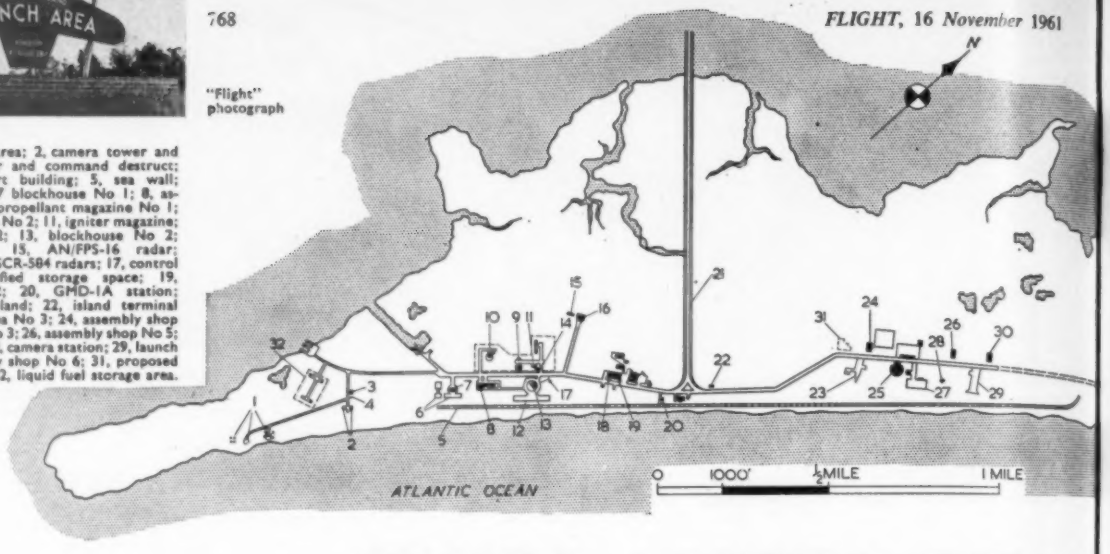
A history of 803 Sqn, Royal Navy, is being prepared by S/Lt C. J. Wilson, and ex-members who can provide information are asked to write to the Staff Officer, 803 Sqn, HMS *Victorious*, c/o GPO, London. It is stated that "any photographs will be welcome, carefully looked after and returned as soon as a copy is made of them."

At RNAS Brawdy, near Haverfordwest, Pembrokeshire, the main runway is being extended, other runways resurfaced and the perimeter tracks reconstructed. The work, which began last month, is due to be completed in a year. It is being carried out by Taylor Woodrow Construction Ltd, who have been awarded a contract by the Admiralty valued at about £600,000.

The annual dinner of Aberdeen University Air Sqn is being held at the Athenaeum Restaurant, Aberdeen, on Saturday, December 2. Past officers and members interested in attending are asked to contact Flt Lt A. D. Meeks, Aberdeen UAS, Fairfield House, Whinhill Road, Aberdeen, by November 20.

No 981 (Allan Glen's) Squadron were awarded the Macfarlane Trophy when they won the Scottish ATC aircraft recognition contest at RAF Turnhouse on November 4. The squadron, which represented Glasgow and the West of Scotland, scored 172 points out of a possible 180. In second place were last year's winners, 2288 (Montrose) Sqn, and in third place was 1140 (Edinburgh) Sqn. Cadet W. G. Allan, of 1232 (Dundee) Sqn, correctly recognized all 60 aircraft, and he and 981 Sqn go forward to the national Air Training Corps contest at White Waltham on December 3.

"Flight" photograph



1, Dovap-ionosphere area; 2, camera tower and station; 3, transmitter and command destruct; 4, transmitter support building; 5, sea wall; 6, launch area No 1; 7 blockhouse No 1; 8, assembly shop No 1; 9, propellant magazine No 1; 10, propellant magazine No 2; 11, igniter magazine; 12, launch area No 2; 13, blockhouse No 2; 14, propellant shop; 15, AN/FPS-16 radar; 16, AFMTC Mod 2 and SCR-584 radars; 17, control tower; 18, dehumidified storage space; 19, assembly shop No 2; 20, GMD-1A station; 21, causeway to mainland; 22, island terminal building; 23, launch area No 3; 24, assembly shop No 4; 25, blockhouse No 3; 26, assembly shop No 5; 27, launch area No 4; 28, camera station; 29, launch area No 5; 30, assembly shop No 6; 31, proposed assembly shop No 3; 32, liquid fuel storage area.

ISLAND LAUNCH-SITE

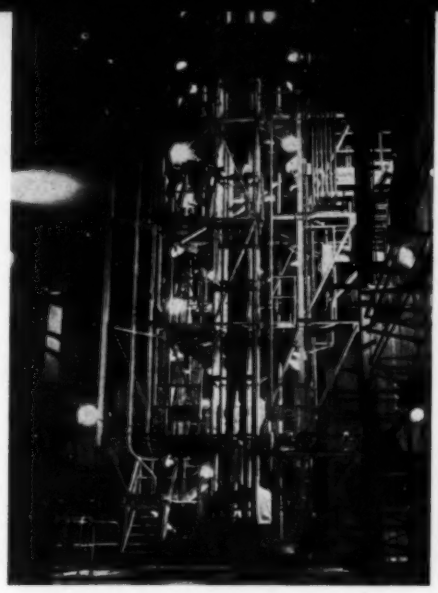
GOOD fishing, shooting and rocketry are among the attractions of Wallops Island, Virginia. Brought into the rocket business by aerodynamicists of the National Advisory Committee for Aeronautics from Langley Field in 1945, and into the space business by the National Aeronautics and Space Administration following its formation in 1958, the island launch-site has grown up with NASA to hold an important place in a number of major space programmes.

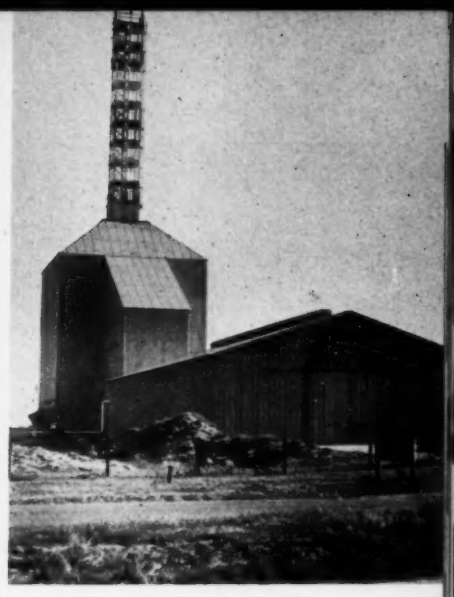
By contrast with the big boosters, the glamour and the publicity of Cape Canaveral, Wallops is a modest operation. Most of the Virginia station's launch pads are simple pieces of tubular or I-beam steel, and most of its launch vehicles are small, reliable solids. Complex service towers in which large and temperamental rockets are groomed for weeks before launch are not needed—the only large service tower there is for the 72ft tall, four-stage Scout.

Located near Chincoteague, Virginia, on the Atlantic coast of the Delmarva Peninsula, Wallops Station has a five-fold mission. First, aeronautical research—a continuation of the early NACA transonic and low-supersonic aerodynamic investigations by means of rocket-boosted free-flight models. The B-70 and supersonic transport designs have been included in more recent aerodynamic work.

Secondly, the development of components and systems for satellite payloads. These can be flight-tested cheaply using rockets; recent examples have included the Little Joe series in Project Mercury and tests of Echo and S-48 ionospheric payloads. Thirdly, sound-

Above, layout and location of Wallops Island. Below, looking north along the shore, with Launch Area No 1 in the foreground





Left, Aerobee 150A in enclosed launch tower prior to recent launch carrying liquid-hydrogen experiment. Right, the launch-tower building. Vehicles are assembled in the single-storey section "Flight" photographs

BY KENNETH OWEN

ing rockets to obtain scientific data from the atmosphere, many of which carry experiments designed by NASA's Goddard Space Flight Center. Wallops is the Space Administration's main sounding-rocket launch site.

A fourth aspect is to provide assistance to government agencies and other scientific groups. This has involved working with UK scientists on the S-51 joint ionospheric satellite until the change from Scout to Delta was made; with Canadians on the joint topside sounder satellite; and with various university groups. The simplicity of launch operations at Wallops makes the station an ideal example for other countries planning to set up their own launch facilities, and scientists from Sweden, Italy and Pakistan have spent periods at the Virginia base for this purpose. Other visiting groups have come from India, Brazil, Venezuela, Britain, West Germany, France, Japan and other countries. As Wallops is a purely civilian establishment, no problem of military security is involved.

The fifth and most recent development at Wallops is the launching of small scientific satellites, made possible by the use of the Scout vehicle. To date successful launchings have comprised Explorer 9 (February 16, 1961), and Explorer 13 (August 25, 1961).

Wallops' participation in most cases does not include the conception of the project, but begins at the design stage when both launch vehicle and payload instrumentation must be tailored to the island's facilities. Wherever the payload is built, a project manager at Wallops will be in touch throughout the construction phase. Next comes the period of preparation for firing, in which clearances are obtained from the FAA, Navy and Air Force (the range area covers a 90° segment out into the Atlantic from 080 -170), and the vehicle is assembled, checked out and mounted on its launcher.

The flight and data-acquisition phases are followed by a period of data reduction, the final element in Wallops' participation. Data analysis, experimental reports and the application of data are the responsibility of the sponsoring group.

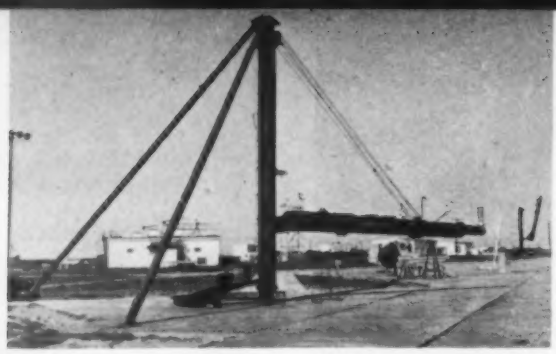
Wallops Station comprises three associated units; the launch area on Wallops Island, a radar site known as Wallops Mainland, and the main base (also on the mainland) which was previously Chincoteague Naval Air Station. Originally NACA occupied only a small part of the island, but since the formation of NASA the island site has been expanded to accommodate new launch pads and other facilities, the two mainland sites have been established, and as many as possible of the personnel and facilities not directly involved in launchings have been transferred to the main base.

The original launch area on the island is Area No 2 (see map), which is a simple concrete pad with four launch locations. Pad 2A has an I-beam, boom-type launcher able to handle vehicles of various sizes, including NASA's five-stage rockets using Honest John as first stage. A tubular-type launcher is mounted on Pad 2B, also able to handle a range of vehicles, including NASA's five-stager based on the XM-33 booster. A small model launcher is located on Pad 2C, while Pad 2D is an area used for mobile launchers such as those for Arcas and for radar test rockets.

This area is served by Blockhouse No 2, which contains telemetry receiving, timing and programming, doppler recording and model instrumentation checkout equipment. As these facilities are transferred to the main base area and elsewhere the blockhouse will be used for personnel protection and to house model checkout equipment.

[*Continued overleaf*

Argo D-4 firing on October 10 to determine density of charged helium and hydrogen atoms in upper ionosphere. Below, Tiros station manager Charles Lundstedt "Flight" photograph below



Simple launchers on Area No 2, the original NACA site. Five-stage vehicles are fired from the foreground launcher "Flight" photograph

ISLAND LAUNCH-SITE . . .

The southernmost launching area on the island, Area No 1, contains the distinctive building shown in the photograph on page 769. This is a combined assembly building and launch tower for sounding rockets such as Aerobee. Assembly and checkout of rockets takes place in the single-storey section of the building, after which the vehicle is mounted in the enclosed vertical-rail tower for final preparation and launching. The entire tower is adjusted to the required launch elevation and azimuth angles.

At the time of my visit an Aerobee 150A was mounted in the tower in preparation for one of a series of a zero-gravity liquid hydrogen experiments in connection with the Centaur engine development programme. The 280lb payload was to be launched to a height of 100 miles and a downrange distance of 50 miles.

The Aerobee tower and two small sounding-rocket launchers on the concrete pad immediately east of the building are served by Blockhouse No 1, which contains both control and telemetry receiving equipment. The area also includes three fixed camera stations; an equipment building which houses a 5,000lb/sq in compressor for charging rocket tanks; and a liquid propellant building for handling, pumping and ready storage of liquid propellants.

On the northern side of the original NACA site is the Scout launching facility located in Launch Area No 3, which comprises a concrete pad, pad terminal building; equipment barrier and Scout launching tower. The tower is 105ft tall and incorporates covered working platforms at various levels.

The series of Little Joe firings in Project Mercury's capsule test programme, now completed, were made from the island's Launch Area 4, which is also equipped with four fixed camera stations.

Multi-stage vehicles such as Trailblazer and Shotput are launched from Area No 5, which has a large concrete pad, one tubular boom-type launcher and seven camera stations. Areas 3, 4 and 5 are served by one blockhouse, a hemispherical concrete structure housing the control and checkout equipment used during the assembly and launch of the relatively large rockets from these pads.

Scout 7 was being prepared for its October 19 launch at the time of my visit. Details of the vehicle and its payload are given later in this article.

The island's various launch facilities are backed up by a number of assembly shops for vehicles and payloads, both on the island itself and at the main base. An eight-bay vehicle assembly shop (No 1) is located between Launch Areas 1 and 2, and is used for the assembly and checkout of test vehicles to be launched. Two of the bays are shielded so that telemetry transmitting equipment may be checked out without interference, and one other has equipment for determining vehicle moment of inertia and centre of gravity.

Assembly Shop No 2, north of Launch Area 2, is used primarily for the assembly and checkout of inert payloads. Assembly Shop No 3, not yet completed, will be used for the Scout vehicle, which at present is handled in Shop 4 (second and fourth stages) and Shop 5 (first and third stages). Large multi-stage vehicles are assembled in Shop 6, opposite Launch Area 5.

Preliminary checkouts and tests of vehicle components and stages using dummy rockets are carried out in a large hangar on the main base, the floor area of which has been divided into four bays.

After the vehicles have been assembled in the assembly shops and launched from the launch pads, there remains the problem of obtaining the scientific data which the flights produce. The complex instrumentation in Blockhouses 1 and 2 includes FM/AM, FM/FM, and PPM/FM telemetry receiving stations. Three tracking sets—AN/FPS-16, modified SCR-584 and AFMTC Mod 2—operate in the radar area; and various communication transmitters (HF, VHF and UFH) and a command destruct transmitting system are located in the radio transmitter building on the south end of the island.

South of the radio building is a Dovap (Doppler velocity and position) and ionosphere station used in conjunction with sounding-rocket firings. In addition to the camera stations on the island, there is a long-range photographic station located approximately 18 miles south of the launching area.

During firing preparations and the actual countdown, control is exercised from the central control building on the island, with the specific test director in charge of the operation. The building contains the central control and co-ordination room; programming timing and communications control equipment; radar data display equipment; a weather station, and range surveillance and other radars.

Typical Test Vehicle Configurations

Sounding Rockets: Aerobee 300A (Sparobee), Nike smoke rocket, Javelin (Argo D4), Viper/Falcon, Aerobee 150A, Nike/Cajun, Strong Arm, Nike/Asp, Arcas, Exos.

Aerodynamic Research: Castor + 2 Recruits/Lance/Lance/Yardbird/T55, Honest John/Nike/Lance/T40/T55/Sin sphere, Honest John/Nike/Nike/Recruit/T55, various air drops and air launches, Honest John/Nike/Gosling, Pollux + 2 Recruits, Honest John/Nike/Nike, Nike/Nike/Recruit, Nike/Nike/Cajun, Honest John/Nike, Nike/Cajun, Little Joe, Gosling, Cajun.

Space Probes and Orbital: Scout.

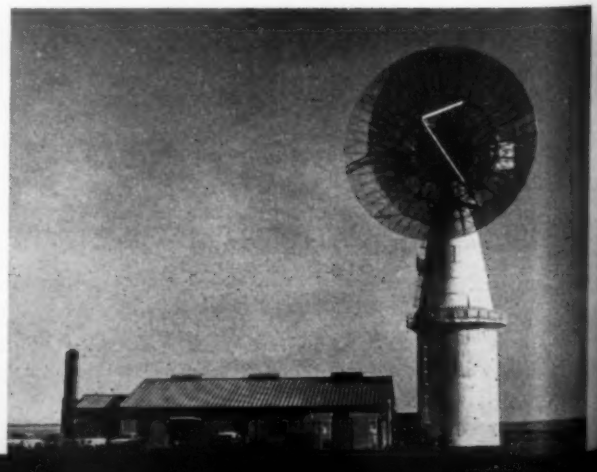
Now nearing completion at the main base at Wallops is a new range control centre, which will take over from the island centre as central control for the launch and data-gathering facilities. A sophisticated communication system has been installed at the new centre, and television observation of the launch-pad scene is provided.

In the early days of rocket firings from Wallops Island, the scientists would cross over to the island in a small boat, complete with equipment and provisions, and would remain there several days until the experiment was completed and they could return to the mainland. Now a long, straight causeway links the island with the mainland, and just across this causeway from the island are the three radar-dish landmarks which identify the "Wallops Mainland" site. These comprise a NASA long-range radar (SPANDAR), AN/SCR-584 radar and Mk 51 tracker, and the field site of Massachusetts Institute of Technology's Lincoln Laboratory.

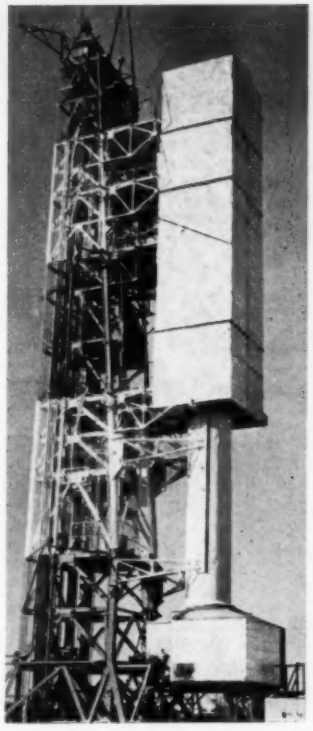
The East-coast data-acquisition station for NASA's Tiros meteorological satellite system is located at Wallops main base. This operates, together with a similar station at San Nicholas Island, California, under the direction of the Tiros technical control centre at Goddard Space Flight Center. Another special facility nearby is a prototype Project Mercury ground station, where initial design problems were tackled and personnel trained. The Mercury headquarters unit, the NASA Space Task Group, is based near Wallops at Langley Research Center, on the side of Chesapeake Bay.

The seventh in the National Aeronautics and Space Administra-

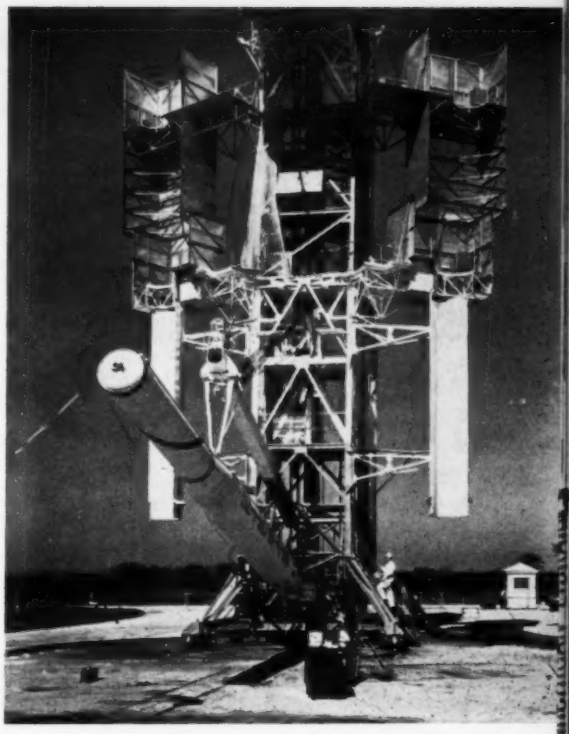
"Wallops Mainland" comprises (left) MIT Lincoln Laboratory's field site, and (right) NASA long-range radar "Flight" photograph



Nike booster stabled in one of the assembly-shop bays "Flight" photograph



Pre-launch view of Scout launcher/servicing tower at Wallops Island, with seventh vehicle mounted but enclosed by protective covers and screened working platforms
"Flight" photograph



Far right, Scout 7 is prepared for mounting on the pad, with tower screens in open position

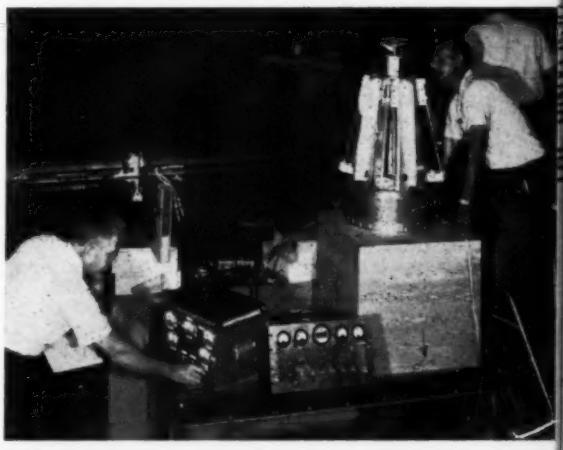
Below right, tests on the P-21 electron-density profile payload at Wallops prior to the October 19 launch. Aerials are seen in the folded position

tion's development series of Scout four-stage, solid-propellant rockets was launched to an altitude of 4,261 miles on October 19, carrying a 94lb payload designed to measure daytime electron concentration and associated ionospheric characteristics.

The P-21 payload carried by Scout 7 was one of a series of four similar ionospheric experiments devised by NASA's Goddard Space Flight Center. On the ascent part of the trajectory continuous-wave signals on 12.267Mc/s and 73.6Mc/s were transmitted; while on the upper and descent phase a swept-radio-frequency impedance probe was used to measure the ionospheric electron concentration. In addition, the performance of the vehicle was telemetered to the ground throughout the flight.

Over 4,500 research vehicles, ranging from single-stage to seven-stage types, have been launched from Wallops Island since 1945. Some of the main types are listed on the opposite page. Many of them, consisting of off-the-shelf stages clipped together in various combinations, do not have individual names.

On the subject of names, it may be of interest to record that the island itself was originally known as Keeckotank and/or Accocomoson and/or Occocomoson. Nearby, for good measure, are Chincoteague, Pocomoke, Bogues Bay, Wamans Bay, Oyster Bay and Hog Creek. The island is named after one John Wallop, Deputy Surveyor of Virginia, who patented the place in 1672. For which NASA must be deeply grateful.



Below, Scout blockhouse prior to the 16-hour countdown for the Scout 7 firing on October 19. The relative simplicity of the blockhouse installation, compared with those for larger, liquid-fuelled rockets, is apparent. Below right, field co-ordinator William Latta, photographed in the blockhouse before the countdown
"Flight" photographs

Straight and Level

TEN out of ten to Sir William Hildred, director-general of IATA. He has taken a tremendous swipe at the supersonic airliner and all it stands for. To speak with the voice of 89 airlines without double-talk or equivocation is Sir William's contribution—no mean one—to world air transport.

I am sure that logic will always prevail in the long run, even in air transport. For my part I welcome the supersonic airliner. I hope that it will come along quickly. The sooner it comes the sooner will its insane economics be seen for what they're worth, and governments and airlines will wake up to the logic of that minimum-cost airliner that has never been built.

With complete faith in the Eventual Prevalence of Logic, I can't wait for supersonics.

● I keep getting letters, often disrespectfully addressed "Dear Rog," from someone whose handwriting looks suspiciously like that of Mr Frank Smith, librarian of the Royal Aeronautical Society. They are giving me a neurosis. This one, for instance:

"Hairsplitting dept., p. 690, col 1, lines 8 and 9: This airline . . . *made* a loss . . . 'Sustained,' perhaps?"

Oh, all *right*.

● The piece referred to above, which was about Ghana Airways (this column, November 2), has brought me another rap over the knuckles, from BOAC. I said that BOAC manages Ghana Airways. As I remarked recently in another context, we all make mistakes, journalists no less than anyone else.

A dozen BOAC staff have been seconded to hold certain senior executive positions in Ghana Airways, but the management of the airline is *not* BOAC's responsibility. Indeed, in its latest annual report, BOAC pointedly remarked that it has "no responsibility for the policy and management of Ghana Airways."

In my piece I said I imagined that BOAC "has warned the Ghana Government of the staggering cost of the policies it is pursuing," and I envisaged the prospect of the BOAC staff being "dismissed on the pretext that it was they who were responsible for the losses."

So I don't think, despite those erroneous words "BOAC manages Ghana Airways," that my knuckles need to be rapped too hard.

● A visiting pilot was being put through the mill by General Precision Systems on their exciting and very realistic visual attachment for flight simulators. He was making an instrument approach in very low ceiling and visibility conditions and waiting hopefully for his first sight of the approach lights and runway on his television screen. He was somewhat astonished, when he broke cloud at 100ft to see a monster fly, apparently 20ft high, sitting amongst the approach lights.

Very unpleasant. The insect was on the 1 : 2,000-scale terrain model and was being viewed at f70 through the 0.020in aperture of the special television camera.

GPS are now making a standard airfield model, instead of replicas of actual airfields. The model is based broadly on Gatwick, and referred to by GPS technicians as Airwick. I hope it's fly-proof.

"Some of the squadron pilots pictured with Greek officers on the steps of the Parthenon," the caption says. But do you remember the photograph I published of Treble One Sqn pilots a year go, all looking in different directions? It appears as though looking around on the ground, as an antidote to sticking together in the air, is an occupational relaxation with 92 Sqn as well

● My most interesting and enlightening reading for weeks has been part one of an account of a visit to Russia by Capt C. C. Jackson, executive secretary of IFALPA. It appears in the November issue of the BALPA journal *The Log*. This is something that I and thousands of others have been awaiting for years. Why, then, is Capt Jackson so coy in supposing that "it is thought that Member Associations would be interested in a brief account"? In part the brevity of the report may be ascribed to Capt Jackson's having lost some of his notes.

Anyway, all praise to him for his concise, clear narrative. I don't know which part I found the most interesting —that dealing with pay and conditions, I think. "The pilot," reports Capt Jackson, "gets two months' paid leave per year and, for one of these, he is entitled to rest at a sanatorium, usually on the Black Sea. In connection with medical standards, we were very interested to learn that the pilots had a brief medical examination (heart, blood pressure, general health) before each flight and that doctors (75 per cent women) were kept at nearly all airports for that purpose."

Capt Jackson's report is recommended reading for all seekers after truth; in which connection I must add a word of praise for his remark that "some allowance should be made for possible misunderstandings due to interpretation problems." I think half our misunderstandings with the Russians are, well, misunderstandings.

● Boeing's Dash 80 prototype is doing a great deal of flap, boundary-layer control, autopilot, anti-skid brake and other tests at the moment. A friend in Boeing writes: "She practically stands still when all the paraphernalia is out in the breeze . . . very strange sight. In fact, now that Douglas have a supersonic transport, we are thinking of advertising the slowest jet transport in the world."

● From the Office of Information, HQ Tactical Air Command, USAF, Langley Air Force Base, Virginia:—

"*Truth is that in today's evil era of communist aggression, TAC's job stretches along a vast continuum: TAC is the triple-threat halfback on the United States Air Force team; TAC is the all-round utility in-fielder; TAC is the clutch player.*"

I hope that TAC's crews don't dress up like American footballers. They'd never get into their cockpits.

● You may remember my comments (November 2 issue) on the An-12, complete with rear gun turret, which came into Gatwick in the markings of Ghana Airways. I said: "Perhaps the empty turret will be used, for a surcharge of course, as an observation lounge." A reader now informs me that it was in fact equipped as a toilet. No surcharge, I hope.

ROGER BACON

ROYAL AIR FORCE/ARMY

Whirlwind Mk.10

Wessex 2

ROYAL SWEDISH AIR FORCE

Augusta Bell 204B

Vertol 107

ROYAL SWEDISH NAVY

Vertol 107

ROYAL SWEDISH ARMY

Augusta Bell 204B

ITALIAN AIR FORCE

Augusta Bell 204B

AGIP

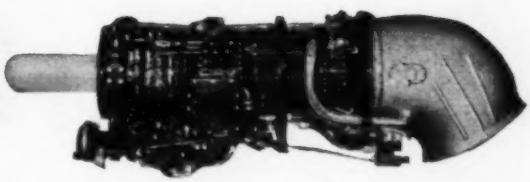
Augusta Bell 204B

GHANA AIR FORCE

Whirlwind Mk.10

The

GNOME



is already in quantity production for important European and overseas operators

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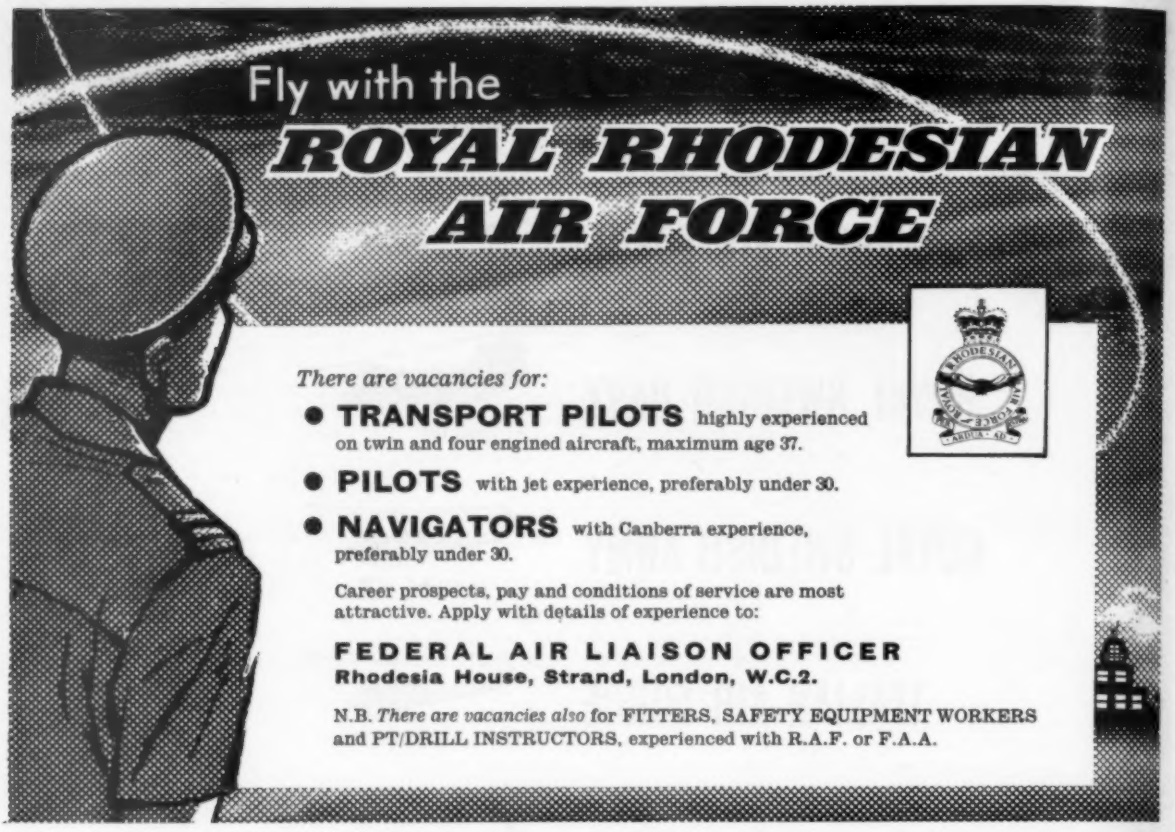

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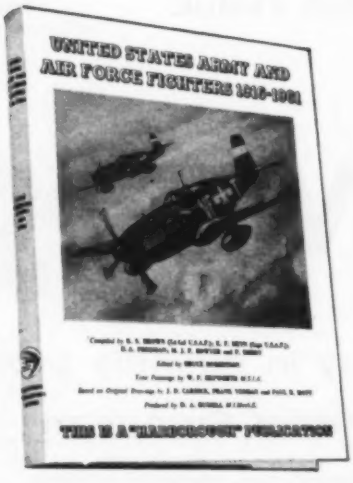
Produced with the co-operation and approval of the Department of the Air Force.

This book covers a period of 45 years of American fighter development, and thus includes the two World Wars, the Korean War and brings the reader right up-to-date to the late summer of 1961. The narrative dealing with the period is concise and accurate, and is illustrated by over 250 photographs.



Other sections of this fine book present 1/72 scale tone drawings of 70 representative types (13 occupying double-pages); an album of 44 selected photographs of famous and experimental types; a 12 page section illustrating 333 Fighter Unit badges, and a 16-page schedule listing 430 types and variants complete with many details of each.

256 pages on art paper, size 8½in. by 11¼in., weight nearly 2¾lb. Full-colour jacket illustration and insert; cloth bound on heavy millboard.

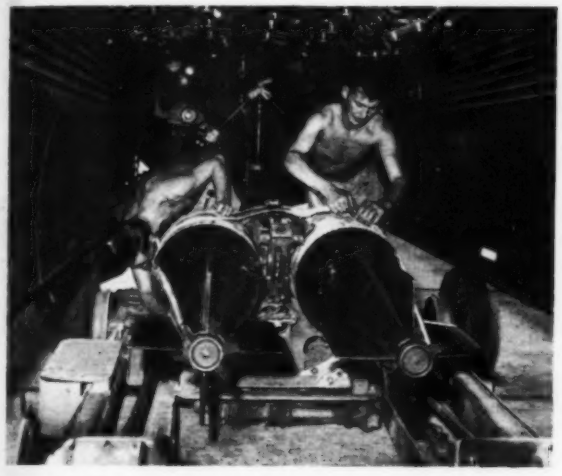
50/-

HARLEYFORD PUBLICATIONS LTD., LETCHWORTH, HERTS.

RHODESIAN SILVER JUBILEE

RRAF Looks Back 25 Years

Canberras of the Royal Rhodesian Air Force, whose assegai symbol can be seen in the roundel, being bombed-up (right). Below left, an inside view of the Canberra bomb-bay during bombing-up operations. At the foot of the page is seen a Canadair C-4 (ex-Argonaut) of the RRAF



EARLY on a sunny morning in 1936 six young men, all volunteers from the Southern Rhodesia Territorial Force, took their first flying lessons with the de Havilland Flying School at Belvedere airfield, Salisbury—and in doing so began the history of the air force in Rhodesia. Now the Royal Rhodesian Air Force has just celebrated the 25th anniversary of the formation of this Territorial Force Air Unit, which has grown from those six men and three loaned aircraft to its present strength of about 1,000 personnel and some of the most up-to-date jets.

The Royal Air Force, with which the Rhodesian Air Force has enjoyed close co-operation since its inception, did not forget the birthday. Mr Julian Amery, Secretary of State for Air, sent a telegram to the Federal Minister of Defence, Mr J. M. Caldicott, conveying the congratulations of the Air Council.

The story of the Air Force in Rhodesia began in 1935 when the Southern Rhodesia Government voted money to raise and train an air unit as a contribution to imperial defence. The following year six pilots began training under instructors from the de Havilland Company, flying before and after their working hours.

In 1937 the air unit was equipped with its own Hawker Harts, which were assembled in Salisbury; and shortly afterwards headquarters were moved from Belvedere to the military airfield at Cranborne. There, in 1938, with the threat of war looming over Europe, training began in real earnest under RAF instructors. On May 12, 1938, the first seven Rhodesian pilots gained their wings.

[*Continued overleaf*

Vampires of the Royal Rhodesian Air Force over Lake Macilwaine —12 miles from Salisbury, and source of the city's water supply

RHODESIAN SILVER JUBILEE . . .

In August 1939 the first Rhodesian squadron took up its war station; and when in September 1939 war broke out, the Air Unit became known from that month onwards as the Southern Rhodesia Air Force. After April 1940 there was a Rhodesian squadron in the Royal Air Force. In 1941 two more Royal Air Force squadrons which had a majority of Rhodesians on their strength became known as "Rhodesia" squadrons. Rhodesian pilots, aircrew and ground staff served with distinction in many theatres of war.

In 1951 the Southern Rhodesia Government undertook to provide two fighter squadrons for Commonwealth Defence and for this purpose 22 Spitfires were flown from England. Three years later, in 1954, the Southern Rhodesia Air Force squadrons were equipped with Vampires.

By this time also the Federation had been born and the SRAF became the Rhodesian Air Force in October 1954. Her Majesty the Queen shortly afterwards conferred upon it the title "Royal."

All the while aircraft of many kinds had been added to the RRAF and today there are altogether about 70, including jet bombers, jet fighters, and conventional piston-engined transports and reconnaissance aeroplanes.

This modern air force is now commanded by AVM A. M. Bentley, OBE, AFC, who as the son of a Rhodesian pioneer won a Governor's cadetship to Cranwell before the war. He served with the RAF until his return to the Southern Rhodesia Staff Corps in 1949, and he has since played a major part in the shaping and development of the Royal Rhodesian Air Force.

THE HARLEYFORD STORY

HARBOROUGH, Harleyford, Hertfordshire—these euphonious alliterations chart the biographical course of Mr. D. A. Russell as editor and publisher. Market Harborough in Leicestershire was where he lived when he first entered aeronautical journalism, as owner and editor of *Aeromodeller* from 1934 onwards. Subsequently he lived in a cottage in the grounds of Harleyford Manor in Buckinghamshire; and since moving to his present home in Letchworth, Hertfordshire, Mr Russell has preserved both names in his aeronautical publishing business. The company is Harleyford Publications Ltd; and each book bears on its dust jacket the imprint "This is a Harborough publication."

Latest of the Harleyford books is *United States Army and Air Force Fighters 1916-1961*, published this month. Its cover shows ten "credits," in addition to the one which says "produced by D. A. Russell, MIMECHE." Listed as compilers are Lt Col K. S. Brown, and Capt E. F. Heyn of the United States Air Force; R. A. Freeman, M. J. F. Bowyer and P. Berry. The editor is Bruce Robertson; and tone paintings—based on original drawings by J. D. Carrick, Frank Yeoman and Paul R. Matt—are by W. F. Hepworth, MSIA.

This list of names indicates two special features about Harleyford Publications—the amount of specialist research which goes into each book, and the international character of the contributors. For example, the compiler and author of the Harleyford's earlier publication *Fokker—the Man and the Aircraft* was Henri Hegener, leading Dutch aviation writer. American co-operation, in the new book about American fighters, has already been mentioned. The German writer Heinz Nowarra was a major contributor to the Harleyford book on von Richthofen; and the Belgian section of *Air Aces of the 1914-1918 War* was contributed by Maj V. Houart of the Belgian Air Force.

Cosmopolitanism is thus one feature of Harleyford productions; another is teamwork. Mr Russell, now in the distinguished-looking fifties, has gathered around him an enthusiastic band of assistants in offices which adjoin his Letchworth home. His wife, who was an ATA pilot during the war, handles the company accounts; his son Capt M. C. Russell, a pilot with Tradair Ltd, is a director. The devoted experts who make up the Harleyford staff form a team who can do under one roof nearly all the jobs involved in compiling these aeronautical books—research, writing, drawing, make-up of pages. All, that is, except the actual printing—which is carried out not far away, by the Garden City Press Ltd, Letchworth.

Harleyford publications are well known throughout the world for two especial qualities—their authority and their attractiveness. Their authority springs from the fact that no effort is spared to make all details accurate. If, when a book is going to press, Mr Russell receives a letter containing some first-hand or new information, he will incorporate it even at the risk of a delay in publication. The books' attractiveness springs from the able contribution by staff artists, in the form of three-dimensional air-brushed drawings; by liberal use of photographs; and by printing on art paper. Two Harleyford artists, J. D. Carrick and Frank Yeoman, are responsible for the drawings; while the company's technical editor, E. F. Cheesman, has responsibility for all technical information.

Mr Russell originally arranged for a first print of up to 5,000 for his books; they are specialist publications, and at 45s somewhat heavy on the pocket of the individual reader. But with the Spitfire book, a first print of 10,000 was ordered and quickly taken up; a further 10,000 print is now in hand. With *United States Army and Air Force Fighters 1916-1961*, a first print of 15,000 has been ordered.

This indicates the growing reputation of Harleyford books, which in a few years have become recognized as authoritative publications on air matters.

The two previous Harleyford issues, *Spitfire—the story of a Famous Fighter*, compiled and written by Bruce Robertson, and *Fokker—the Man and the Aircraft*, with Henri Hegener as compiler and author, maintain the high standards set by these books: beauty of format, an accurate and detailed text, a wealth of illustrations admirably combining information with aesthetic appeal.

Titles for 1962 and 1963 are already in preparation. Ideas—of which, says Mr Russell, there is never any shortage—are already under consideration for the years beyond. One thing seems certain: there will never be any lowering of standards by the enthusiastic and expert Harleyford team.

Members of the Harleyford team: seated clockwise round the table are Mr Bruce Robertson, Mr W. M. Lamberton, Herr H. J. Nowarra (German correspondent), Mrs D. A. Russell (chairman and director), Lt Col K. S. Brown (US correspondent), Capt M. C. Russell (director), Mr F. A. Yeoman; standing, Mr J. D. Carrick, Mr W. F. Hepworth, Mr D. A. Russell (managing director) and Mr E. F. Cheesman

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. The names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Rearward-facing Seats

THE subject of backward-facing seats has gradually acquired a fascinating complexity. Roger Bacon (October 26) has now uncovered another facet of this. I have no doubt the ARB knows that the seat and sitter must be regarded as a structural unit, and that a 6g backward-facing unit is no stronger than a 6g forward-facing one. The crux of the matter is that while a 9g forward-facing unit is impossible (the sitter would fail in the middle), a 9g backward-facing unit is easy.

The pity is that although properly emplaced sitters and fuselage shells are already good for something like 30g, this bonus is wasted by using forward-facing seats. The operators are carrying all this unused structure and failing to make capital out of it. Why not increased safety instead of caviar sandwiches?

Surbiton, Surrey R. C. ABEL

IN your issue of October 16, your columnist Roger Bacon quotes the views of an anonymous member of the aviation industry on the Air Registration Board's attitude to backward-facing seats. The suggestion is that the Board impedes the fitting of backward-facing seats by requiring them to be stressed to 9g (or higher) while accepting the continued use of 6g forward-facing seats.

The true position is that since 1951 the Board has required new types of aircraft to be equipped with 9g seats whether they be backward or forward facing. There is, however, a backlog of older aircraft originally designed to 6g standards. When operators re-equip these aircraft with new seats the Board presses for a raising of strength, where practicable, to the 9g standard, and this attitude applies whether forward- or backward-facing seats are involved.

However, the strength of the floor is often the limiting factor. Generally, under crash-loading conditions a backward-facing seat imposes greater stresses in the floor structure than does a forward-facing seat. Hence, in an older aircraft with a 6g floor, it is often impossible (unless re-design of the floor is undertaken) to fit backward-facing seats without going well below 6g.

So far as actual seats are concerned, the Board has approved, in the last four years, over 20 types of rearward-facing 6g seats for use in re-equipping older aircraft.

London WC2 R. E. HARDINGHAM,
Secretary and Chief Executive, Air Registration Board

BUA's Balance Sheet

IN your issue of November 2 you publish on page 682 an appreciation of the annual accounts of British United Airways in which you imply that the profits of the group resulted from operations other than those bearing the "British United label."

With the exception of the Morton/Olley and Channel Air Bridge operations, all United Kingdom based fixed-wing operations carried on by members of the group are "fronted" in the name of British United Airways, and during the year 1960 these combined operations resulted in a substantial surplus. This is not apparent from the accounts, which are prepared to comply with statutory requirements.

The trading results of the other activities of the group, including helicopter and overseas operations and the engineering division, were also satisfactory.

London W1 R. LOUDON CUMMING,
Financial Director, British United Airways Ltd

Is the Freighter the Answer?

THE national demonstration on November 2 by members of ASSET (Association of Supervisory Staffs Executives and Technicians) in favour of this country committing herself to building a supersonic airliner commends itself as an unusual and enterprising action by a trade union. One can fully sympathize with the objectives of getting the Government to commit itself to a forward plan for the aircraft industry, to consult with the Commonwealth airlines and to provide credit assistance to help sales to foreign airlines where necessary. But is the vast investment required to develop a supersonic airliner—one estimate puts it at £100m to get a satisfactory prototype flying—the best use for our resources? One remembers the Princess flying-boats, the Brabazon, the Blue Streak. . . .

In past days a notable feature of Britain's leading position was the fact that she was the world's largest carrier of goods by sea. Why should not this country now set out, with Government assistance, to become the world's No 1 air cargo carrier?

Freighters, which we already know how to build, may not be so spectacular as a supersonic airliner; nor are lorries, buses and tractors for the millions as glamorous as the super sports cars for the few. But there is little doubt about which are of greater use to mankind or are likely to provide a better living for the industry concerned.

Derby R. P. DUCE

Titov's Space-sickness

IT was reported in *Flight* (October 19) that a paper read at the 12th Astronautical Congress stated that, for a considerable part of his trip, Titov suffered from a vestibular upsets resembling sea-sickness. This "space-sickness" was brought on "when the astronaut sharply turned his head or was observing swiftly moving objects."

However, at the Moscow press conference Titov gave the very opposite impression. He stated that he had felt no ill-effects whatsoever whilst in orbit. This is also borne out by a film (admittedly doctored) recently shown in Moscow depicting parts of seven of the twelve orbits during which Titov was awake.

The above report raises another query. What were the "fast moving objects"? Clouds? When travelling at 18,000 m.p.h. what difference would it make if clouds a hundred miles beneath you were travelling at 100 m.p.h. in any direction? If not clouds, what? Shooting stars? The lone comradely sputnik still in orbit? Or could it simply have been hallucinations brought about by Titov's retrospective vestibular indisposition?

London N4 J. E. W. SURMAN

[At the Moscow press conference on August 11 Prof Vladimir Yazdovsky said that Titov's prolonged stay in conditions of zero gravity had produced "some changes in the vestibular apparatus" which had sometimes led to "unpleasant sensations." When the cosmonaut assumed the correct position and made no sharp movements with his head, however, "those sensations disappeared almost entirely." This was repeated and amplified in the IAF paper in Washington last month by Yazdovsky and Gazenko.—Ed.]

Propellers for Profits

IN this day and age of the turbojet, it would appear to a layman reading a selection of modern aeronautical literature that the propeller is an obsolete, useless appendage. This is far from being true, but the accusations levelled at it may be summarized as follows: (1) the jet cruises faster than the propeller aircraft and can therefore make more trips in a given period, thus earning more money; (2) the jet's maintenance costs are lower, owing to the lack of a reduction gear and propeller system; (3) the first cost is lower.

Yet there is plenty of evidence to show that the propeller is the way to make hard cash, not paper profits and "prestige."

First, it will be agreed that the propeller, due to its greater Froude efficiency, uses less fuel in carrying a given payload from A to B, and any increase in economy achieved by the jet can be duplicated on the turboprop, since the gas producer is basically similar.

As to the question of cruising speeds, the margin is only some 25 per cent (600-450 m.p.h.), but over longer ranges this is a valid argument. On shorter stages, the question of "stack" time, and additional fuel burnt by the jet in the lower levels of the stack, both increase the jet's costs and decreases its speed advantage. Thus, as stack time becomes a higher proportion of journey time, the jet's advantage fades to nothing and leaves the propeller as the more economical by virtue of its lower fuel bill.

Even on longer stages, there is an argument for the propeller, assuming that fares were related to journey cost, which of course is not currently true, thanks to IATA. Then the lower fuel cost of the propeller would be reflected in a lower fare, which would therefore result in a higher load factor. In that case the extra profit per journey might well outweigh the extra journeys of the jet, particularly as the break-even load factor tends to be higher on the latter.

On the question of maintenance costs, the propeller's salvation lies in the hands of the manufacturers themselves. If a modern propeller installation can be developed to possess "fit and forget" reliability, and therefore have negligible maintenance costs, this point becomes groundless and the saving in fuel a net economy. However, it is only fair to point out that the complexities of a modern propeller system present quite a problem to the reliability and development engineer. On the other hand, the increase in complexity between a modern propeller and one of its immediate predecessors is no greater than that between, say, a DC-3 propeller

CORRESPONDENCE...

and the fixed-pitch wooden ones preceding it. There were undoubtedly many "teething troubles" with the DC-3's props, but now they have achieved virtually "fit and forget" reliability.

At first sight the point about first cost is unanswerable, but if the above answers to the first two accusations are satisfactory, then the increased cost represents an investment which will give a satisfactory return.

Some of the secondary advantages accruing from the use of the propeller are as follows: (1) reduced airport noise, due to both lower frequency and intensity, and to the propeller's superior rate of climb; (2) reduction in the cost of replacement tyres and brakes due to the use of brake pitch, which (again due to greater Froude efficiency) is more efficient than a jet's reverse thrust; (3) simplified parking problems, since the damage caused by slipstream will be far less than that caused by jet efflux; and furthermore, with Beta control, backing up to a loading ramp, and even embarking passengers with the engines running in zero pitch, become practical possibilities.

The turbofan is sometimes claimed to be an efficient compromise between the two methods of propulsion, but what is the fan part of a turbofan but a multi-bladed, fixed-pitch propeller, rendered even less efficient by running in a duct?

In conclusion, one may ask whether the airlines, in ordering bigger, noisier and more expensive jets, are really doing their job of providing a safe, fast and cheap alternative to surface travel. This is not achieved by flying "expense-account" passengers and a few wealthy people across the Atlantic in the lap of a luxury carried to almost ridiculous extremes, but by firms like Silver City flying Mr and Mrs Everyman, the kids and the car to France or elsewhere for their summer holiday. The best money-making aircraft ever built to date is undoubtedly the DC-3. Surely the reason is that it is cheap, reliable and adequately comfortable for the stage-lengths of which it is capable; not luxurious, not silent, not vibration-free, but cheap to buy and to fly and as reliable as the proverbial train.

Suppose that instead of making bigger, faster and more concrete-devouring jets, the manufacturers built smaller, slower and cheaper STOL aircraft capable of operating from any quarter-mile strip of grass. It should be possible to operate an aircraft of this type over stages of up to 500 or 1,000 miles at fares comparable to the 2d-odd per mile currently charged by British Railways. It is pointed out that 1,000 fares at £5 each amount to the same sum as 20 at £250, but there are many thousands more people with the former sum to spend on travel than the latter, so the potential market is immense. This is the way to make real money out of flying aeroplanes, as Silver City have found, compared to some other carriers' "profits" which are confined to the annual accounts.

In this connection it may be remembered that the Breguet 941, whether or not a success technically or commercially, is in its way as much of a technical break-through as were the Boeing 247 and DC-3. This is because it is not designed to fly higher and faster, with a bigger payload, than any other aircraft of similar all-up weight, but rather that it must take-off and land in less space, and be cheaper to operate than any other comparable aircraft, whilst maintaining a reasonable cruising speed and altitude.

This is the sort of aeroplane to make money, not "prestige." Indeed, to paraphrase a well-known (propeller-driven) aircraft advertisement, "all the propeller can offer operators is a way to make money."

Stevenage, Herts — S. REW

STOL in 1919

YOUR photograph in your issue of October 26 of Védrines' Caudron on the roof of the Galeries Lafayette reminds me that when I was at the North-Eastern Area Flying Instructors' School at Redcar in January 1919 we heard of the occurrence, which was I think to earn a prize for the first roof-top landing.

We told the CO, Maj MacMinnies, that Harrods were offering a prize of £1,000 for the first aviator to land on their roof. The major at once wrote and offered to do so, only to receive a reply that they were prepared to pay him almost that sum to keep off their roof!

London SW1 — G. M. KNOCKER Gp Capt (Ret)

Air Traffic Control by Computer

PHASE 1 OF SATCO SYSTEM IN SERVICE

A RECENT visit to Amsterdam's Schiphol Airport enabled me (writes a correspondent) to see the operation of SATCO Phase I at close quarters and to obtain some impressions of its capabilities. My hosts were the air traffic control staff and, later, representatives of Hollandse Signaalapparaten NV, of Hengelo.

The introduction by Signaal of this equipment, and the additional complementary equipments to come, represent a great step forward in the advancement of traffic-control techniques. This year the Netherlands Department of Civil Aviation has gained some experience in the operation of Phase I in its ATCC at Schiphol. There was an initial "debugging" period and one for training purposes in 1960, following which SATCO ("Signaal Automatic Air Traffic Control") was put into operation in January of this year.

Phase I consists of a fully transistorized, unduplicated digital computer with teleprinters and strip-printers as the means of input and output. The system covers the airways and terminal areas in Holland and also caters for "off-airways" flights in the FIR. Its main purpose is to serve the controllers in the Area Control Centre at Schiphol by providing them with a rapid means of calculating all types of flight-path and by displaying the results in the form of printed progress-strips, which are then used for the regulation of traffic in much the same way as was the old manual system. The increase in efficiency and the saving in labour expected from this phase will thus chiefly concern mental arithmetic and clerical work.

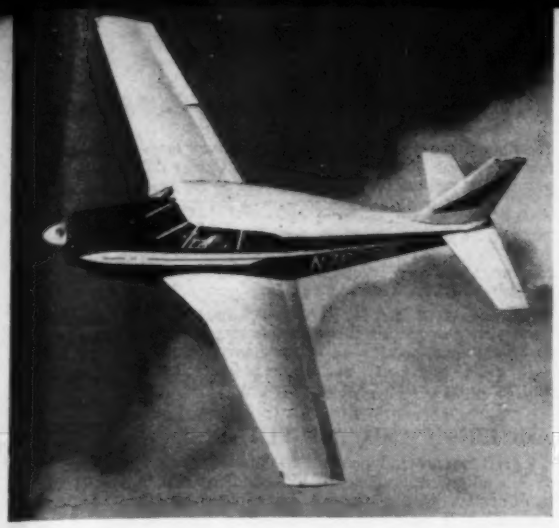
Technical experience so far has suggested that the performance and reliability of the computer are satisfactory. Apart from half a day's maintenance per fortnight and two periods of one week each (when the system was switched off for major changes) the computer has now been operating 24 hours a day since October 1960. During this time there have been 17 breakdowns (each averaging about one-and-a-half hours to trace and rectify) thus giving a serviceability factor of a little more than 99 per cent. With the duplicate computers which will be installed in Phase II it is expected that serviceability will be very close indeed to 100 per cent. The great majority of failures concerned transistors. Out of more than 8,000 transistors in the computer, 40 failed during 11 months of operation. By contrast, of the 3,000 diodes, only one failed; and there have been no failures of resistors. Performance of the main memories—ferrite core stores and magnetic memory drum—has been entirely satisfactory.

The performance of the input/output printers has not been as good as that of the computer itself, but the situation has now been much improved by replacing the original equipment with printers of a later type from the same manufacturer. The noise of the printers has been damped by a novel design of sound-absorbing cabinet. Each printer is installed in one of these cabinets, and although they are within a few feet of the controllers they operate without distracting them from the R/T and telephone traffic.

Operationally, many lessons have been learned. The principal lesson is that, even with inputs and outputs that differ only very slightly in format and presentation from those of the old manual system, "on the job" training of assistants and D-controllers is unwise. Although some initial training was, of course, given with simulated traffic, it proved insufficient. The result was that in the first two or three months of operational use, both controllers and ATC assistants—particularly at peak periods, when they naturally had no time to bother with new-fangled gadgets—tended to revert to the old ways of ball-point and paper. Since then, however, two major changes have been made in the programme unit of the computer. Additionally, the controllers found that the colour of the paper strips under artificial light left much to be desired; so both the quality and the shade of the blue strips has been improved, and certain other changes in organization have been made. All these modifications are designed both to meet the criticisms of the controllers and to make the switch from manual to automatic much more smooth than was originally thought necessary.

The impression one gets in the Schiphol Centre is certainly one of great neatness of the format of the flight strips; one also feels that here is the beginning of much saving in time and effort of the kind currently expended in most ATCCs of the world. All flights through Schiphol are now put through SATCO. For various reasons (perhaps tinged with the fact that traditions in ATC die hard) some controllers and assistants did not appear too happy with their new toy; but the majority appear to be satisfied and, indeed, some are noticeably enthusiastic about the system. More important, the lessons that have been learned have proved invaluable in the design of Phase II, which is now in production and is scheduled for delivery towards the end of 1962.

In the introduction of any automatic system of this nature there are bound to be teething difficulties on both sides. To some, inevitably, the computer is to ball-point as the diesel is to steam; but whatever the opinion of the drivers—as Signaal themselves point out—their system cannot replace the controller.



Piper Comanche 250 *New-type Lycoming 0-540 engine with extensive ruggedizing for increased wear resistance . . . Electrically operated Max-Lift slotted flaps, new function-shaped gear and flap controls . . . Quiet, roomy four-place cabin has been restyled with durable fabrics in rich new colors . . . Simplified starting is assured with new "shower of sparks" magnetos . . . New super plush version . . . New "Palm Beach" interior . . . Seat upholstery is done in genuine leather*

Piper Aztec B *Spacious seating for six . . . Three-tone paint design available in choice of four color combinations . . . Engines are two new ruggedized 250 h.p. Lycomings and all major systems are dualized . . . Two front seats are contour-shaped in sports car bucket seat configuration for added comfort . . . The third seat accommodates two people commodiously . . . Design configuration constitutes much higher degree of utilization of total fuselage cubic area than is customary*

Sport and Business

SIX FOR '62

Some of Next Year's Models in Makers' Words and Pictures

Cessna 150 *The sporty Model 150 features a host of new '62 advancements including increased cruise and climb performance, main Land-O-Matic gear relocation, redesigned wingtips . . . Large airplane capability with an optional "family seat" designed to permit "children" to accompany their parents on aerial outings . . . Interior trim appointments include "Beige" Elastolex headliner, Beige "Foam Step" carpeting and non-glare Black Royalite panel . . . Durable new fabrics*

Cessna Skyknight *Functionally designed for executive needs as a speedy airborne conference room, the spacious interior features stretch-out, move-around room . . . comfortable poly-cloud seats . . . draw curtains, fold-away writing desk, airliner-type ventilators, ash trays, cigarette and cigar lighters, magazine and map pockets, hat and accessory shelf, coat hooks and a "Blend-temp" heating system which attains full output in 15 seconds . . . A dyna focal engine mount system*

Beechcraft Debonair *Some of the most beautiful colors and harmonious patterns yet found in a business airplane . . . New front chairs with three-position fore-and-aft adjustment and four-position reclining adjustment for stretch-out comfort, new "perfect posture" high-back rear seats. Redesigned swept vertical stabilizer . . . Most streamlined appearance . . . Removable, shock-mounted panel with custom die moulded glare shield . . . Result of extensive researching*

Beechcraft Queen Air *All-new interior styling, a striking new paint design and extra cabin space highlight improvements to the new Model 65 . . . The pace-setting Queen Air has been acclaimed the ultimate in its class . . . Rich grain leather upholstery, tasteful wood side paneling and deep pile wall-to-wall nylon carpeting accentuate the all-new custom-tailored cabin arrangements . . . Additional passenger comfort is assured with new "perfect posture" high-back chairs*

This fine picture of the Aviation Traders' Carvair landing at Southend was taken last week from an Airwork Services Cessna 180 flown by the company's chief test pilot Joe Tyszko. A note on the new Channel Air Bridge Carvair services appears on the opposite page

AIR COMMERCE

FROM CRUMBS TO CAKE

IN reviewing last year's report of the British Independent Air Transport Association (*Flight*, November 11, 1960, page 758), we hoped that, as the Association grew in strength, it would come to publish more about itself. The hope has not yet materialized; the BIATA report for 1960-61,* valuable though it is in many ways, offers no more than has been published in previous years.

Particularly disappointing is the absence of scheduled traffic statistics broken down independent by independent. This information is given by BIATA members to the Ministry, who forward it to ICAO, who then publish it in their annual *Digest* of traffic statistics. It is reasonable to expect that information about BIATA members soon to be available, for instance, in Indonesia would appear in BIATA's report; but only the collective traffic figures published six months ago by the Ministry are given.

Nevertheless, this is virtually the only official text on Britain's independents—a notable exception being British United's balance sheet, published a few weeks ago. That document was indicative of a realization among the more solid independents (a realization fostered by the 1960 Act and by the Air Transport Licensing Board) that public transport operators must expect to be asked to publish more about themselves. This seems to be accepted in principle, if not yet in practice, by BIATA: Mr Clive Hunting of British United Airways, the Association's president, says in his report that independents must come to "accept a greater degree of public accountability."

The useful new information in the report, as in the past, relates to the non-scheduled operations which account for some two-thirds of BIATA's total effort. Total non-scheduled loads went up 12 per cent, while capacity went up 24 per cent, both increases being the biggest for five years. All types of non-scheduled business showed substantial increases, except for freight ton-mileage. Scheduled traffic, as the already published Ministry figures show, went up healthily under every heading, total capacity going up 26 per cent, and total load ton-miles up 20 per cent. Overall load scheduled factor was 63.8 per cent. Inclusive-tour traffic recovered from the "distressing" recession of the previous year with an increase of 24 per cent.

Last November there were 12 BIATA independents, and 11 non-BIATA independents. This year there are 13 BIATA members and, significantly, only two survivors of last year's non-BIATAs (though a handful of newcomers have come on the scene). The big challenge to BIATA now comes not from the non-BIATA Johnny-come-latelys; it comes from within the Association itself. BIATA's *raison d'etre* was the need for small companies to huddle together for warmth and political unity in a cold corporation-monopolized world. Only a few years ago members had to be content with the crumbs under the corporations' table; they are now allowed to sit round the table, within reach of some quite scrumptious slices of cake. Now that at least two BIATA members are in—or nearly in—the Big League to which they have for so long aspired, it remains to be seen whether this will strengthen or loosen the ties that bind BIATA together.

Footnote Last Tuesday BIATA was due to hold its annual dinner, invariably an occasion for plain speaking, which we hope to report in a subsequent issue. As is customary, the Minister of Aviation will be the chief guest. It is thought likely that Mr Clive Hunting will continue as BIATA's president in 1961-62.

* The British Independent Air Transport Association, Annual Report for 1960-61, published by BIATA at 8 Waterloo Place, London SW1, telephone Whitehall 6676.

AIR LINKS AND THE FUTURE

WHILE many independent companies are finding it hard to stay afloat, not all small independents are finding themselves in difficulty. One of these is Air Links, who operate DC-3s from Gatwick and who recently obtained a fresh infusion of capital. The company is now expanding its activities, although negotiations for the purchase of a DC-6B from Canadian Pacific recently broke down.

The company has had to decide whether to suspend operations or to carry on with its DC-3s, and the decision has been taken to carry on. Indeed, Capt D. Martin, the managing director, said last week that the company is seeking to "expand into turboprops in 1963." Additional office accommodation has recently been acquired at Gatwick.

VISION IN JERSEY

IMPORTANT changes in Jersey Airlines are anticipated by the formation of the Channel Islands International Airlines Corporation Ltd. The day on which this company (CIAC for short) came into being at the Jersey Royal Court was November 4, a day which Mr M. L. Thomas, chairman and managing director of Jersey Airlines, describes as "the realization of a vision."

The idea behind CIAC, which has a nominal capital of £1m, is to prepare the way for the expansion of air transport in the Channel Islands. In time CIAC will probably acquire Jersey Airlines. Other companies might also be acquired in the same way that British United has established a strong independent front to compete with the corporations and big foreign airlines. Jersey Airlines will, Mr Thomas emphasizes, retain its trade name, as probably will any other airline acquired by CIAC. He hopes, too, that shares will be made available to the public. It is, he says, of "fundamental importance" that the new company should be registered and controlled in the Channel Islands.

It will be recalled that last month BEA relinguished its 25 per cent shareholding in Jersey Airlines. Perhaps this move was related to Mr Thomas's plans for CIAC, though he emphasizes that "our future does not necessarily lie in direct competition with existing airlines." There is, he says, scope already at hand for new local service operations, and he cites the 20 US local service airlines as typifying the kind of air transport which has never been developed in Europe.

On show for the first time on November 8 was the new long-haul terminal at London Heathrow, a note about which appears on the opposite page. The picture on the right provides a general view of the departures hall in this attractive new terminal. Shown on the facing page is a general view of the main concourse

This BOAC 707 is being washed down at London Airport by men in protective clothing as a precaution against contamination by radiation. Precautions are also being taken by personnel engaged on engine overhaul work. A number of airlines have reported traces of radiation on their airliners, following the recent series of Russian nuclear tests, though the level is said to be well below that where passengers might suffer harm

CAR FERRY ERA 2

LONG-HAUL vehicle ferry services have been talked about for so long that they have inevitably aroused some scepticism. But now firm dates have been fixed by Channel Air Bridge, a British United Airways company, for the inauguration of three new routes thrusting into the heart of the Continent. On April 2 a twice-weekly Carvair service to Geneva will be inaugurated, followed on April 6 by a twice-weekly service to Basle. These frequencies will rise to five and four respectively during the summer. And on April 11 a twice-weekly service to Strasbourg, becoming a daily service during the summer, will begin.

So far as the bogy words "subject to Government approval" are concerned, Swiss consent to the Basle and Geneva services is signed and sealed, and French agreement-in-principle to the Strasbourg service has been given.

It is the Aviation Traders ATL-98 Carvair which has made possible this new and revolutionary phase in the development of vehicle-ferry air transport. Any doubts there may have been about the Carvair project when it was announced have been completely dispelled by the remarkable development progress made by this major DC-4 modification. The first aircraft, G-ANYB, was last week undergoing its final ARB handling assessment, having completed (in more than 110 hours' flying since June 21) the major part of its certification programme. There is cautious optimism at Southend that, if all goes well, certification should be achieved in a few weeks' time. The second Carvair is nearing completion at Stansted and is to fly in January: the third will fly in February.

Channel Air Bridge will also use Carvairs on the existing short-haul Bristol Freighter routes from Southend to Calais, Ostend and Rotterdam. The public's first taste of Carvair service will probably be on the Rotterdam route towards the end of January.

A big expansion in Channel Air Bridge's business, which has undoubtedly been held back by the limited vehicle and passenger capacity of the airline's nine Bristol Freighters, can be expected when the Carvairs are in operation. During 1961 about 32,500 cars will have been carried on the routes from Southend to Ostend, Calais and Rotterdam; during 1962 it is expected that about 48,500 —half as many again—will be carried on these and the new routes.

Addition of Geneva, Basle and Strasbourg means that the Air Bridge's present route-mileage of 330, slowly and steadily built up over seven years, will be increased at one stroke to 1,640. In terms of value for £ s d, motorists will now be able to take their cars for —very broadly—five times the distance into Europe for three times the fare. Prices are related to the superior economics of the Carvair, which has an hourly flying cost only £8 or so more than that of the Bristol Freighter, but which has about double the productivity—7½ tons at 200 m.p.h. compared with around 4¾ tons at 155 m.p.h. The Carvair will also offer its 23 passengers a considerably higher standard of comfort and quietness.

Channel Air Bridge had, by last Friday, taken bookings for 203 cars and some 600 passengers on the new routes—an encouraging sign of a demand for services not yet advertised.

IMPERIAL AIRLINES DISASTER

SEVENTY-FOUR US Army recruits were killed when a Constellation of Imperial Airlines crashed near Richmond, Va, on November 8. Three of the crew and four other passengers also lost their lives. The pilot, Capt Ronald Conway, 29, and the flight engineer, Mr W. F. Poythress, 30, survived. The accident was one of the worst disasters in the USA involving one aircraft. It is reported that two of the four engines had failed and the aircraft was attempting an emergency landing.

The accident is likely to increase FAA concern about the safety standards of US independents, following the accident last September to a DC-6B of President Airlines at Shannon, when 83 people were killed. According to the FAA, Imperial Airlines has been disciplined twice in the last two years for air safety violations. In 1950 it was fined $1,000 for carrying 30 Marines in an unairworthy C-46; and last March the FAA revoked the licences of three Imperial pilots for flying in conditions which were alleged to have endangered the lives of the military men on board. In September 1953 an Imperial aircraft crashed in California killing 19 soldiers and a crew of two. The airline is known to have at least two Constellations, one of which was previously owned by BOAC.

LONDON'S FINE NEW TERMINAL

LONDON Heathrow Airport's new long-haul passenger building came into partial operation on Monday morning when passengers on the 10 a.m. BOAC Comet flight were handled through the new building. At the moment only outward BOAC flights (and services by those companies for whom BOAC act as handling agents) are using the new building; long-haul incoming passengers are using the present international section of the short-haul building. This state of affairs will last until next April when it is hoped to bring the new building into full operation. Thereafter all long-haul flights, both inward and outward, will make use of No. 3 Passenger Building, as the new facility is officially named. Those airlines which are continuing to use the "temporary" London Airport North buildings are PanAm, TWA, PIA, Panair do Brasil, Aerolineas Argentinas, El Al and Air-India.

At present slightly over half of the 430ft by 280ft main building is in use. This will eventually be flanked by two 411ft by 55ft office blocks, but at the moment work is in hand only on the southern part; work is scheduled to start in the near future on the northern block, and this is due for completion in 1963. By then the whole project will have cost in the region of £3m. During this early period the maximum distance that passengers will have to walk from arriving at the building to boarding their aircraft will be 150 yards. When the flanking blocks are completed the maximum walking distance will then be 330 yards. There will be stands for 30 aircraft around the building. It is estimated that by 1965 some 2,050,000 long-haul passengers will be passing through the airport (compared with last year's total of 1,093,000), and that by 1970 the total will have risen to 3,130,000.

The Ministry of Aviation describe No 3 Passenger Building as "functional in intention, rectangular in shape, with glazed galleries, cast stone fascia, domed roof lights and upswept ventilation outlets." It is difficult to think of a more unimaginative description for a building that will surely rank as the finest that has been erected at the airport. Functional it may be, but both in the standard and the "eye appeal" of the interior finish this is a first-class example of British design and workmanship. In these columns we have, on more than one occasion recently, commented on the poor standard of UK airport design, but the new building is as good as anything that can be seen at New York International or at Kastrup. It will be interesting to see what treatment is accorded the restaurant which will be located in the south block.

D.H. Comet 4Cs of MEA have been airlifting 1,500 Scandinavian troops of the United Nations Emergency Force in the Middle East from Beirut to Oslo and Copenhagen, and bringing back 1,500 fresh troops to take their place. The homeward-bound troops were flown from El Arish in the Gaza Strip to Beirut by three RCAF D.H. Caribous assigned to the UNEF. The number of troops carried by three Caribous makes up one Comet load of 98 officers and men

AIR COMMERCE . . .

INFINITY WILL NOT BE VULGARIZED

DURING the passage of the Civil Aviation Licensing Bill through Parliament in the spring of 1960 the question of bringing sky-writing, banner-towing and aerial advertising under some form of licensing control was heatedly discussed. One Member objected to aerial advertising as "the vulgarization of infinity," and his views seemed to be echoed by the Minister of Aviation and by Parliament. Section 7 of the Act, which prohibits aerial advertising and propaganda, is now due to come into force on January 1, 1962.

From that date the only circumstances in which an aircraft—to quote the Ministry—"may emit or display any communication or advertise in such a way that it is audible or visible from the ground" are prescribed in the Civil Aviation (Aerial Advertising) Regulations, 1961, issued on November 6. The regulations extend to gliders, kites and balloons (the Minister has even given thought to the use of toy balloons, which he has decided to exempt from the regulations).

Briefly, therefore, aerial advertising is to be completely prohibited. There will never again be sky-writing over the British Isles, nor sky-shouting, nor banner-towing nor any advertising except for what might be described as official purposes.

US FARES DILEMMA

A MOVE to increase domestic fares is now being made by some US carriers. United Air Lines, for example, has asked the CAB for permission to increase jet and propeller coach fares by 5 per cent, plus $1 per single ticket, and to eliminate propeller night coach fares. In addition, the airline wants to increase first-class jet and propeller fares by $1 per ticket. It is also proposed that the existing jet surcharges shall be integrated into the new fare structure.

In addition to the basic problem of excess jet capacity, US airlines are disturbed at the inroads being made by coach fares into first-class revenues. The CAB has been encouraging the industry to reduce frills before increasing fares, and this is believed to have been one of the main items for discussion by the 11 US airline presidents at a meeting with the CAB last month in Washington. The result was the elimination by most airlines of drink and meal services from coach-class flights, one exception being Continental. Meanwhile there has been widespread disenchantment with the results of the promotional "youth fare" plan, which has been dropped by eight of the 18 carriers which adopted it.

National, too, has asked the CAB for permission to raise coach fares—from the existing level of 75 per cent of first-class fares to 85 per cent.

One US airline, however, is not only resisting the all too easy temptation to increase fares when traffic is falling short, but is actually seeking approval for lower jet coach fares. Continental Airlines, in what it describes as "a major move to bring the cost of jet travel within the reach of millions of non-flying Americans," is planning "drastic reductions" in jet fares from December 1. Fares would be 25 per cent lower than present jet coach fares. They would be described as economy class and would be available on all the company's "Golden Jet" 707 services. There would be no change in existing first-class or coach ("Club Coach") services. The interior of each Golden Jet would be revised to accommodate 75 economy seats, of special lightweight Teco design, in addition to 36 coach seats and 28 first-class seats. Present configuration is 44 first-class and 76 coach-class. There would be no meal service to the economy passengers.

It seems likely that the CAB will be disposed to approve Continental's plan to boost revenues rather than that of those carriers who are choosing the shorter-term expedient of increasing fares. Mr Robert Six, the president of Continental, says: "We believe that jet economy fares will generate enough new air travel to increase the industry's profits."

BOAC'S SURPLUS PROPELLERS

A NEW feature has appeared in *BOAC News*, entitled "From the Managing Director's Desk." In the first issue, dated November 3, Sir Basil Smallpeice announces a plan—unprecedented in BOAC's recent history—deliberately to reduce capacity next year on the western routes. The reduction will be only small, but it represents a major reappraisal of the corporation's policy, evident during the past two or three years, to make its greatest production efforts on western routes. For example, during the 12 months ended June 1961 (the latest 12-month period for which figures are available), BOAC increased its western-routes output by no less than 53.6 per cent, while traffic went up by only (relatively speaking) 30.3 per cent—load factor being 51.5 per cent. In the month of June itself an increase in available capacity of no less than 65 per cent was recorded, for a traffic increase of only 17.2 per cent. Obviously the corporation cannot continue to over-schedule on this scale.

As recorded last week, some 707 capacity will be redeployed on the eastern routes. On these routes capacity and traffic have been more successfully related, capacity increase during the 12 months ending June 1961 being 18.7 per cent, with traffic going up by 15.6 per cent. Overall load factor was 63.1 per cent, compared with 51.5 per cent on the western routes. Boeing 707s will operate to the Far East, linking with the trans-Pacific 707 services at Tokyo, and the surplus Comet hours that are thrown up will be redeployed on the West African routes to Nigeria and Ghana.

This will, in turn, inevitably increase the corporation's surplus of propeller capacity; and Sir Basil Smallpeice announces that the fleet of eight DC-7Cs will be retired in April and the 13 Britannia 102s (another is leased to Malayan) in about 12 months' time.

Efforts to sell DC-7Cs have been made for a year or more past, and these efforts have been intensified in recent months. The news that Riddle Airlines of Miami is purchasing ten more DC-7Cs to bring its fleet of these aircraft up to 20 inevitably raises the question of how hard the corporation has tried to dispose of its DC-7Cs. Seven years ago, when the corporation ordered ten of these aircraft as an insurance against late delivery of the Britannia 312s, it gave the Minister an "express undertaking" that the aircraft would be sold when the Britannias were in scheduled service on the North Atlantic. This condition was later relaxed so that the DC-7Cs could be retained until the corporation's 15 Boeing 707s were delivered. The fifteenth and last 707 was, in fact, delivered in January 1961.

Meanwhile, not only Riddle have bought 20 used DC-7Cs but

The Sikorsky S-61L became the world's first twin-turbine helicopter to be certificated when, at Stratford, Conn, on October 31, Mr Najeeb E. Halaby, administrator of the FAA (right), presented final certification papers to Mr Lee S. Johnson, Sikorsky's general manager (left). Looking on is Mr Fred W. Milam, vice-president of Los Angeles Airways, which is putting the new helicopter into scheduled passenger service next month

TWA's new terminal at New York International Airport, due to be opened in March next year, is designed to "capture all the grace and beauty of flight." The terminal is located just to the left of the international arrivals building

other operators also have acquired these aircraft, including the US supplementary airline President, and the UK independent Caledonian. The two BOAC DC-7Cs that were converted by Douglas to DC-7F standard have been doing a useful all-freighting job, achieving results that have been beyond the corporation's expectations. The eight DC-7Cs have not been employed on scheduled services for some time but have, say the corporation, been fully employed on charter work. During the 24 weeks beginning April 1, 1961, the corporation's eight DC-7Cs flew 7,659hr on charter work. At the same time the corporation's Britannias have not been idle, fewer hours though they have been flying on scheduled work. For example, 13 Britannia 102s during the 24-week period beginning April 1 flew 4,064hr on charter work, whilst 17 Britannia 312s flew 5,687 charter hours.

But, as Sir Basil Smallpeice says, these propeller aircraft "are no longer earning any significant contribution towards their obsolescence."

DC-8's NEW WING APPROVED

APPROVAL of the FAA has been given to the DC-8's leading edge wing modification. This approval permits installation of the reshaped leading edge on aircraft already delivered as well as on those scheduled for delivery. Six airlines, including Alitalia, Japan Air Lines, KLM, National, Trans-Caribbean and Philippine Air Lines, have already signed contracts for 16 of the modified DC-8s. In addition Alitalia, Canadian Pacific and United will modify 12 aircraft already in service.

During flight tests of the new leading edge the DC-8 became, Douglas claim, the first transport to fly faster than M1. The aircraft flew in fact slightly beyond M1 and also exceeded the official altitude record for jet transports by carrying the equivalent of its normal payload above 52,000ft.

According to Mr Jackson R. McGowen, vice-president general manager of Douglas Aircraft Division, "sharpening the leading edge and extending the chord or width of the wing 4 per cent stretches the range of the DC-8 and increases the margin of speed between the Douglas transport and other passenger jets now in service. Despite the leading edge re-design, the outstanding low speed stability characteristics of the DC-8 remain unchanged. These new jets can take off and land at lower speeds than any other passenger aircraft of comparable size." The DC-8F Jet Trader, announced earlier this year as a combination cargo and passenger carrier, would," Mr McGowen said, "have both the new leading edge and turbofan engines to achieve maximum efficiency."

MEA's BUSINESS BOOMS

DURING a difficult period for world air transport, Middle East Airlines reports a 37 per cent increase in traffic during the first nine months of 1961. The most spectacular increases during this period were on the London - Beirut - London routes which recorded increases of no less than 245 per cent. Total traffic on the route rose 66 per cent, from 10,665 passengers in 1960 to 17,716 in 1961, of which MEA carried 11,558. MEA traffic in and out of Frankfurt was also up by over three times, and on the airlines' Rome services the number of passengers increased by 50 per cent.

Total passenger traffic carried by all airlines on MEA's Comet 4C and Viscount routes, serving 26 cities on a 20,000-mile network, rose by 15 per cent, and MEA captured more than one-third of this increase compared with the same period last year. From May to September MEA's share of traffic in fact rose by 40 per cent.

As already recorded, one of the first consequences of MEA's divorce from BOAC was an alignment with Jordanian air transport, which has been completely reorganized by the Jordanian Government by the formation of a single carrier, Jordanair (see *Flight*, October 5, page 565).

JET NOISE IN COURT?

WHAT rights have local residents against airport owners and users whose noise can make life unbearable? There is nothing in the statute book of England which gives the citizen any specific rights. The Minister, by enforcing noise-abatement procedures and by limiting jet activities by night, has done a great deal to fulfil his obligations as guardian of the public interest. But in the view of the Noise Abatement Society he has not done enough. Indeed, this society is now contemplating an action in the High Court against the Minister.

The society's secretary, Mr John Connell, says: "We are basing our argument on a case in which the Esso Petroleum Co was taken to the High Court for causing noise." Mr Justice Veale held that "a man is entitled to sleep during the night in his own house."

INDEPENDENT SAFETY STANDARDS

ONCE again the subject of air safety has been raised in the Commons, and the Minister has published some statistics. These are given in the table below, as published in *Hansard* for November 6. It will be seen that no attempt has been made to draw any conclusions, nor even to add up the figures. Pressed by Mr Mason to indicate whether the figures prove that the independents have a higher accident rate than the corporations, the Parliamentary Secretary, Mr C. M. Woodhouse, said: "I suggest that the hon Gentleman should study the figures before asking further questions."

Glaringly omitted from the statistics are the recent independent fatalities which have prompted all the fuss.

Scheduled Passenger-carrying Flights by UK Operators

Calendar Year	Corporations		Independents	
	Passengers killed	Passenger-miles flown (millions)	Passengers killed	Passenger-miles flown (millions)
1952	—	1,206.4	—	26.6
1953	61	1,379.9	—	52.5
1954	84	1,432.4	—	80.0
1955	13	1,681.5	—	119.9
1956	29	1,955.2	—	148.8
1957	17	2,200.7	38	174.0
1958	26	2,378.2	—	186.5
1959	—	3,055.5	—	214.6
1960	—	3,691.7	—	272.3

Non-scheduled Passenger-carrying Flights by UK Operators

Financial Year*	BOAC†		Independents‡	
	Passengers killed	Passenger-miles flown (millions)	Passengers killed	Passenger-miles flown(millions)
1952–53	—	35.1	33 (+6 non-BIATA)	229.2
1953–54	—	56.9	—	401.8
1954–55	—	31.3	—	492.2
1955–56	—	50.2	47	677.5
1956–57	—	54.4	33	717.8
1957–58	—	91.6	35	596.2
1958–59	—	98.5	—	672.4
1959–60	—	112.2	29	616.1
1960–61	—	355.8	—	675.7

*Such passenger-mile figures as are available for non-scheduled flights are for financial years. The corporation figures are for years ended March 31; the figures for independents are for years ended June 30 up to 1958–59 and for years ended March 31 from 1959–60 onwards.

† British European Airways do not maintain records of passenger-miles on non-scheduled flights. There were 22 passenger fatalities on British European Airways non-scheduled flights in 1957–58.

‡ The only figures available of passenger-miles on non-scheduled flights by independent companies are those published by BIATA and the passenger-mile figures shown therefore exclude operators not belonging to the Association. For the sake of comparability, passenger fatalities have been confined to those on services of BIATA members except in the one case specially noted. [Ministry footnote]

Fatality rate per 100m passenger-miles, scheduled and non-scheduled, for the corporations (excluding BEA in respect of non-scheduled operations—see footnote to table) works out at 1.16. The equivalent figure for the independents, scheduled and non-scheduled operations works out at 3.32. On the basis of passenger-miles flown, therefore, the independents' safety record appears to be nearly three times worse than that of the corporations.

A *Flight* assessment of the comparative safety rate, published in our issue of October 19 (page 643), was based on total capacity ton-miles on all services from June 1955 to mid-October 1961. The comparison on this basis suggested a record for the independents eight times worse than that of the corporations.

Clearly, much depends on whatever index is chosen; every index has serious shortcomings, as was discussed in our analysis. But it is probable that, by whatever standard the two sectors of British air transport are compared, the safety record of the BIATA independents *as a whole* is inferior to that of the corporations.

It was expected that, last Tuesday, air safety would be debated by the House.

A new version of Boeing's mobile Turbo-Starter, incorporating an improved version of the company's gas turbine compressor, is in production. Designated 502-12B, the new 250 h.p. compressor has turbine wheels with mechanically attached blades, a new nozzle box, and improved "hot" materials

AIR COMMERCE...

BELFAST'S NEW AIRPORT

A NEW terminal building, estimated to cost £720,000, is to be built at RAF Aldergrove, as briefly reported a fortnight ago. It will replace the present civil airport at Nutts Corner. Work is due to be completed in 1963.

Aldergrove was selected because of its greater potential for development to meet the requirements of expanding traffic and because of its better approaches and runways. Delays and diversions will be less likely, as its two 6,000ft runways will be able to cater for wind conditions which at Nutts Corner would call for diversions.

The new terminal will be self-contained, entirely separate from RAF installations, and will be under civil administration. RAF activities will continue at the aerodrome. The new terminal is planned to cater initially for traffic growth up to 1968, when more than 900,000 people are expected to pass through at the rate of about 600 per hour in the peak periods. The apron will accommodate ten aircraft but, like the terminal, is designed to be extended as demand requires. A freight hangar is to be built by BEA, who will also build other accommodation, for aircraft catering and vehicle servicing.

The main building, clad principally in glass with solid grey brick panels, is simple in design. Its main feature will be the treatment of the roof, an independent structure of undulating appearance. Inside, all concrete surfaces will be in natural finish, as at Gatwick. Floors will be covered principally with hard-wearing decorative tiles, while shops, snack bar and restaurant for 180 people will be in aluminium and timber. The architects are W. H. McAlister & Partners Ltd, of Belfast. Yorke, Rosenberg & Mardall, responsible for the Gatwick terminal, acted as planning consultants. Mechanical and electrical consultant is J. R. W. Murland, of Belfast; civil engineering and structural consultants are Clarke, Nicholls & Marcel, of London and Belfast; and quantity surveyors are W. H. Stevens & Sons, of Belfast.

The apron is designed by the Ministry of Aviation. All contract arrangements, together with supervision of construction, will be carried out by the Air Ministry on behalf of the Ministry of Aviation.

BREVITIES

KLM has bought for air survey work a Pilatus Porter C.6, to replace its old D.H.86.

It is reported that MEA is considering the purchase of eight BAC One-Elevens for delivery during the first quarter of 1964.

Air France has confirmed its order for four Boeing 707-320Bs (P & W JT3D-3 turbofans) for delivery in 1963. The airline already has 20 Boeing 707-320s delivered or on order.

In an amendment to the air agreement between India and France signed in New Delhi recently, Air-India's 707s will be allowed to operate four, instead of three, services a week to the USA *via* Paris. Air France operates four Boeing services a week to and through India.

TWA reports a net loss, after tax credits, of $12,733,000 (about £4.5m) for the first nine months of 1961. This compares with a profit of about $6,083,000 (about £2.2m) during the first nine months of 1960. The loss is due almost entirely to reduced load factors.

It was stated in the Commons last week by the Parliamentary Secretary to the Ministry of Aviation, Mr C. M. Woodhouse, that the Air Transport Licensing Board will make it a condition of inclusive tour licences that the name of the air operator and the type of aircraft to be used shall always be advertised.

Recent British United evidence before the Air Transport Licensing Board indicates that results on the company's services from London to the Canary Islands, to Las Palmas and Tenerife have been disappointing. The services began this year and achieved a load factor of only 21 per cent to Las Palmas and 11 per cent to Tenerife.

Tenders have been invited for the design and construction of a multi-storey car park, to be completed in 1963, at London Heathrow Central. In addition, the Ministry of Aviation is discussing with private concerns the possibility of improving and expanding the arrangements for parking outside the airport and for ferrying the cars to and from the central area.

During the second quarter of 1961 European member carriers of the Air Research Bureau (Aer Lingus, Air France, Alitalia, BOAC, BEA, DLH, Finnair, Iberia, Icelandair, LKM, SAS, Sabena and Swissair) increased seat-mile output on intra European routes by 20 per cent while passenger-miles increased 13 per cent. Load factor fell from 60.3 per cent to 56.5 per cent.

Representing the Merchant Air Service at the Cenotaph on Remembrance Day on November 12 were Capt E. W. Lowden of BEA, who laid a wreath on behalf of the Service; and Capt R. I. B. Winn of BOAC, who represented the Service at Westminster Abbey. Capt J. F. Johnson of Silver City, Navigating Officer G. Thompson of British United, and Radio Officer A. Youngman of Skyways took part in the march with the RAF to the Cenotaph.

The Civil Aviation (Eurocontrol) Bill was presented in the Commons on November 6.

Mr G. H. C. Lee, commercial director of BOAC, has been appointed to the board of the corporation.

The manufacturer of the seats in Skyways' Avro 748 was incorrectly named in last week's issue. The manufacturer is Flying Services Engineering and Equipment Ltd.

According to a spokesman for Lufthansa, the German airline is discussing with BEA the possibility of a joint Argosy freight operation between Britain and Germany. This could lead to an order for Argosy 200s by Lufthansa.

On November 13 work started on British United's new passenger terminal at Victoria Station, London. A short ceremony was attended by Mr W. T. Fearne, Victoria's station master, and Mr F. A. Laker, the airline's executive director.

Next Tuesday, November 21, is the date set by the ATLB for the first day of the big hearings into applications for African routes by British United and BOAC. Other dates allocated are November 22, 23, 28, 29 and 30. Hearings begin each day at 10.45.

Caledonian Airways is leasing DC-7Cs from Sabena, who will deliver the first aircraft on November 15. The number of aircraft involved has not been stated. Caledonian will operate the aircraft in 104-seat configuration on charter services, and major maintenance will be carried out by Sabena.

Air Holdings has been registered as a private company to acquire not less than 90 per cent of the issued share capital of British United Airways, the independent airline owned mainly by British and Commonwealth Shipping and Furness Withy. Air Holdings will act as an investment holding company and be used for the amalgamation of BUA interests and for the rationalization of the various activities of the group.

Mr Michael J. Whelan has been appointed sales manager of Aer Lingus. He was formerly sales development manager for the company in North America

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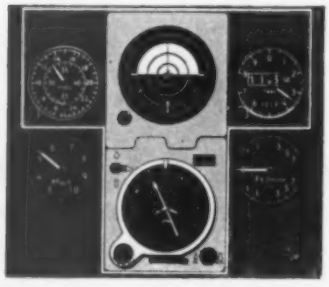
The main pilot's basic instrument display of the flight control systems reflects the layout of the central controller, thereby introducing a natural relationship between the two. The presentation shown here has been designed for the D.H. Trident *and illustrates the clear and positive displays achieved.*



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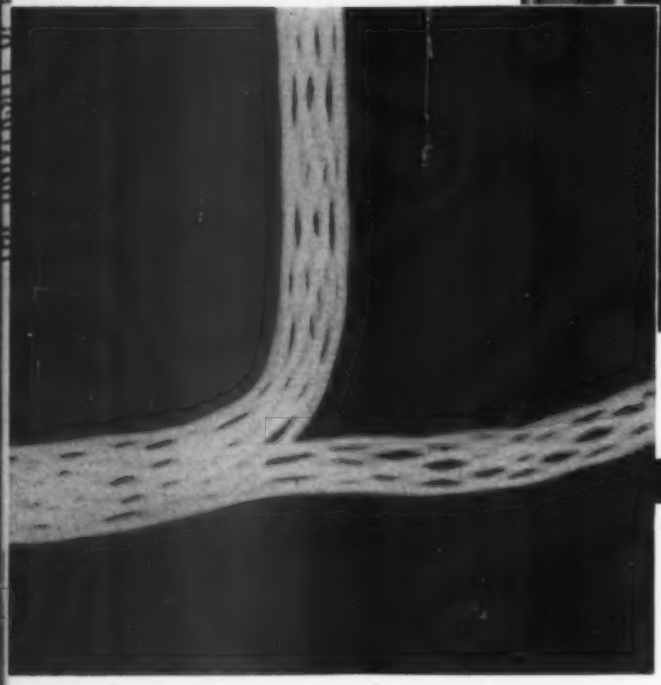

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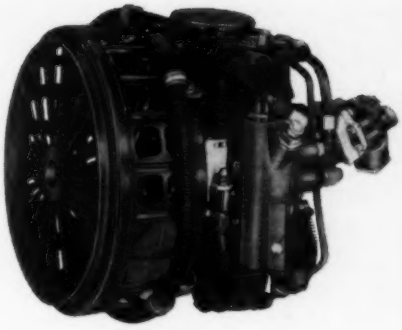

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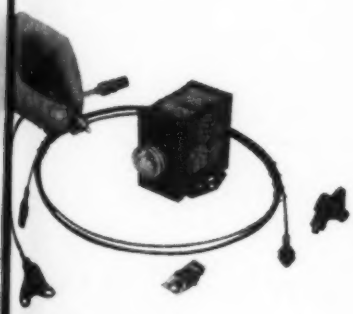

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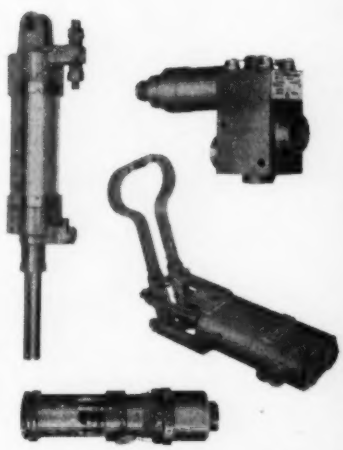

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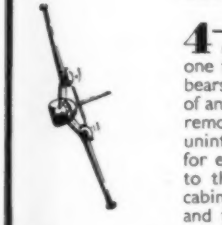

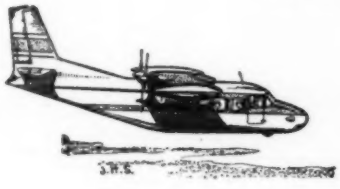

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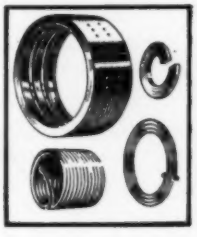

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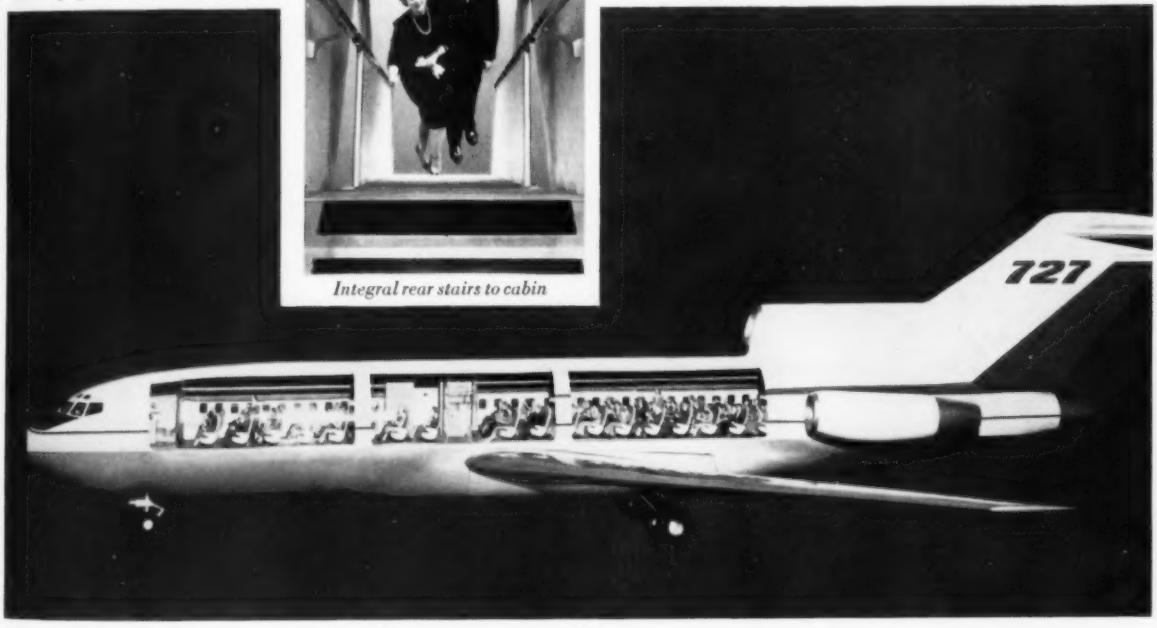
Preview of the new short-range Boeing 727

727 has 3 rear-mounted engines

Mock-up of 1st class cabin section

Integral rear stairs to cabin

Wide 727 cabin permits 6-abreast high density seating



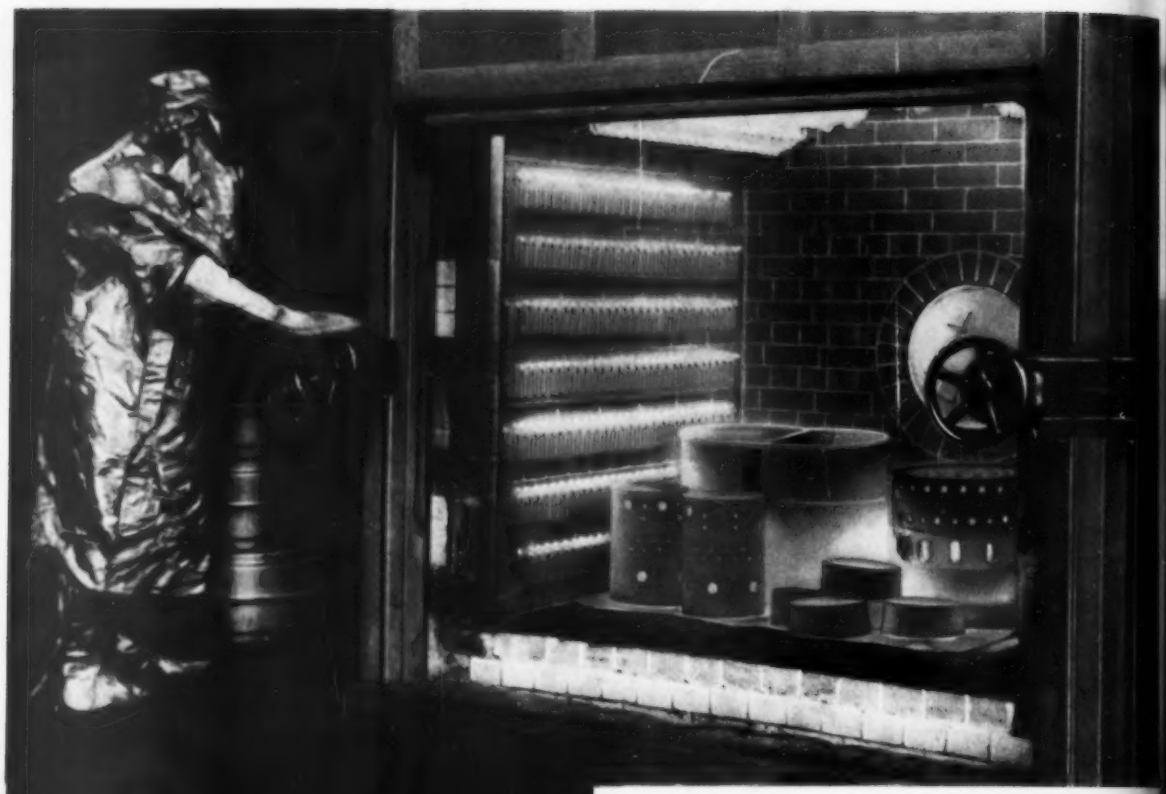
Shown above are photos of scale models and a full-size mock-up illustrating some of the outstanding features of the new Boeing 727 short-range jetliner.

Designed to produce an operating profit even at modest load factors, the 727 is a high-performance jet that will service 150- to 1700-mile routes, operating from 5000 foot runways with full payload.

The 727 brings airlines many short-route features, including quick takeoff, rapid climb to cruise altitude, low approach speed, the durability required for frequent takeoffs and landings, and integral airborne stairs to help reduce ground time during short stops. Capacity ranges from 70 first-class to 113 tourist-class passengers, plus 850 cubic feet of heated and pressurized cargo space. Another unique 727 advantage is the incorporation of many systems and components proved out in more than 350,000,000 miles of Boeing jetliner operations.

Already, American Airlines, Eastern Air Lines, Lufthansa German Airlines and United Air Lines have ordered 117 Boeing 727s for delivery beginning late in 1963.

BOEING 727



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